Appendix A
Biological Survey
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(September 1996)

EAST KAPOLEI MASTER PLAN

BIOLOGICAL SURVEY

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For: PBR Hawaii
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INTRODUCTION

The project site occupies approximately 1300 acres in Honouliuli, Ewa District, Oahu. It encompasses the former sugar cane lands mauka of Varona Village from approximately 60' elevation, up to Farrington Highway. Two sections extend mauka to the H-1 Freeway. The west is bordered by the Kapolei development and the east boundary runs through abandoned sugar cane fields.

Ripperton and Hosaka (1942) classified the vegetation of the region as one of lowland shrub with a coastal fringe of kiawe trees (Prosopis pallida). Because of the arid conditions of the region the vegetation cover is generally sparse. Dominant shrubs include klu (Acacia farnesiana), koa-haole (Leucaena leucocephala) and 'ilima (Sida fallax) and the herb layer generally consists of annual grasses such as bristly foxtail (Setaria verticillata), swollen fingergrass (Chloris barbata) and feather fingergrass (Chloris virgata). In the foothills mauka of the flat lowlands where rainfall is more abundant the vegetation is denser and the herb layer includes Spanish needle (Bidens pilosa), false mallow (Malvastrum coromandelianum), cockelbur (Xanthium strumarium) and pili (Heteropogon contortus) in addition to the annual grasses of the lowlands.

Several recent surveys have been conducted in certain portions of the subject property and in the adjacent lands. In 1990 Funk completed a biological survey of the land immediately east and makai of the project site, including the village of Ewa (Funk 1990). Among the vegetation types recognized were Sugar Cane Fields, Ruderal Fields and Fallow Fields. These communities were characterized by actively cultivated sugar cane fields, abandoned cane fields, common "weedy" introduced plants and lowland wayside species including those mentioned by Ripperton and Hosaka (1942). Similar vegetation was found in the region immediately east of the subject property where common wayside species including koa-haole, Guinea grass (Panicum maximum) and cultivated and abandoned sugar cane fields were found to be prevalent (Funk 1994). Many of these same species were also present in the area between Varona Village and the golf course just makai of the project site (Nagata 1996) and in Kaloi Gulch (Nagata 1994).

METHODS AND MATERIAL

A walk-through survey was conducted in all plant communities between mid-September and early October, 1996 to determine the floristic compostition of the project site. Transects were established throughout the site and all plants observed were recorded and their relative abundance determined. In conjunction

with the plant survey a cursory inventory of animals was also made. All birds and mammals observed along the transects were recorded and listening posts were established at regular intervals. No quantitative analyses was attempted, however, and nests were not investigated.

RESULTS

FLORA

Virtually all of the lowlands and foothills in the Ewa-Honoŭliuli region has been altered by the cultivation of sugar cane. In the past several years certain lands have been taken out of sugar and put to other use, eg. diversified agriculture, urbanization, fallowing. Consequently, the vegetation of these lands are entirely secondary and the vegetation in the region is largely determined by the history of cultivation (or disturbance) on each individual parcel of land, ie. how long the cane field has been abandoned, whether the land was recently tilled, etc. Based mostly on these criteria, eight plant communities were recognized. Although these are drawn with discreet boundaries on the vegetation map it must be remembered that such finite boundaries do not exist in nature. Rather, each community exists as a continuum wth one blending into another. Furthermore, the survey was conducted during the dry season. Species composition and vegetational cover will differ somewhat during the rainy season.

(1) Abandoned Cane Fields (ACF)

This is the largest vegetation type in the project site, representing the most recently abandoned sugar cane fields. Here, sugar cane generally accounts for about 50% of the total vegetational cover. In some areas the cane is 15' tall, robust and still very dense. In most areas, however, the cane is senile, less than 7' tall and accounts for as little as 30% of the total vegetational cover. In fields that have been abandoned for a longer period or where growing conditions were not optimal the clumps of cane are mostly dead or dying. Even in these fields these decrepit clumps are still in distinct rows. The vegetation between clumps usually consist of a mixed herb cover of 'ilima, Guinea grass, radiate fingergrass (Chloris radiata), 'uhaloa (Waltheria indica), hoary abutilon (Abutilon incanum), fuzzy rattlepod (Crotalaria incana), peria (Momordica charantia var. abbreviata) and nut grass (Cyperus rotundus). Total vegetational cover is generally about 75-90%; only where the cane is vigorous and dense is the cover up to 100%.

In some areas such as along the Ewa boundary fence the abundance of cane

is very low and the vegetation approaches that of the Fallow Fields. Here the vegetation is more open with more exposed ground. 'Ilima, 'uhaloa, peria, hoary abutilon and little bell (Ipomoea triloba) are abundant.

Fallowed Fields

The Fallowed Fields are those sugar cane fields which have been abandoned for such a long time that almost no living cane remain. Dead and dying clumps generally constitute less than 5% of the total cover. Dead cane stalks may litter the ground and planting furrows may still be evident but these fields are often difficult to recognize as sugar cane fields without close examination. Two Fallowed Fields subcommunities were recognized depending on the relative abundance of grasses.

(2) Fallowed Fields Mixed Herb Association (Fmh)

Typically the vegetation in this community is less than 4' tall and consists of a mixture of 'uhaloa, radiate fingergrass, 'ilima, hoary abutilon, false mallow, buffelgrass (Cenchrus ciliaris), golden crown-beard (Verbesina encelioides) and coat buttons (Tridax procumbens). Small isolated stands of dying cane occur in certain portions of this community. Small patches of Guinea grass and/or radiate fingergrass can also be found. These grasses along with swollen fingergrass (Chloris barbata), sourgrass (Digitaria insularis) and Natal redtop (Rhynchelytrum repens) are especially common in the mauka portions of this community. Along the road delineating the makai boundary the vegetational cover is only about 50%. Pa'uohi'iaka (Jacquemontia ovalifolia) is common in this open area. Several stands of dead or dying cane also occur here.

(3) Fallowed Fields Grassland Association (Fg)

In certain areas the fallowed cane fields are dominated by Guinea grass and/or radiate fingergrass. Almost no standing cane remain although the furrows are still more or less intact and fallen cane stalks are occasional throughout the community. In most areas the grass cover is 100% but small communities and individuals of 'ilima, hoary abutilon and false mallow are scattered through certain portions and swollen fingergrass and sourgrass are common in other areas.

(4) Abandoned Fields (A)

Several former cane fields in the mauka portion along Palehua Road and between Farrington Highway and the H-1 Freeway have been tilled or graded sometime in the past. The ground is quite level with few stones and although some sugar cane is resprouting the planting furrows are gone. These fields were probably planted in some crop in years past but are now overgrown with mostly 'uhaloa, fuzzy rattlepod,

nut grass and little bell. In one field mauka of Farrington Highway Guinea grass is abundant but in most of the Abandoned Fields this species is not quite so prevalent. Re-sprouting sugar cane is also common in the mauka portion of this field. Golden crown-beard, peria and hoary abutilon are common in some of the fields.

(5) Cultivated Fields (C)

Cultivated Fields are fields which have been recently plowed, actually planted in a crop (other than sugar cane), or which have been put to some urban use. Of the five fields designated as Cultivated Fields, three have been recently plowed. The vegetation in these consist mostly of seedling little bell, peria, fuzzy rattlepod, 'uhaloa, castor bean (Ricinus communis), graceful spurge (Chamaesyce hypericifolia) and re-sprouting nut grass. Vegetational cover is about 25-50%. In two fields watermelons (Citrellus lanatus) have been planted and along the Ewa boundary fence an approximately two-acre site has been graded and turned into a parking lot. Approximately half of this field has been paved with gravel. Most of the vegetation in this portion consist of Amaranthus viridis and nut grass. The vegetation in the ungravelled portion consist of peria, nut grass, 'uhaloa, radiate fingergrass, false mallow and re-sprouting sugar cane.

(6) Grasslands (GR)

Grasslands represent those lands which apparently have not been tilled, graded or planted in any crop including sugar cane. This community exists only on the steepest slopes just makai of the H-1 Freeway and is the smallest of all the vegetation types in the project site. The vegetation is one of Guinea grass 1-2' tall with emergent klu, koa-haole, and kiawe. On eroded slopes, 'ilima, false mallow, 'uhaloa, Beorhavia coccinea, garden spurge (Chamaesyce hirta) and virgate mimosa (Desmanthus virgatus) are found in small numbers.

(7) Gulch Association (GU)

Kaloi Gulch together with its tributary Hunehune Gulch represents the only natural drainage system in the project site. The vegetation in the gulches is characterized by extremely dense stands of Guinea grass 5-10' tall. So dense is this layer that very few other species are present. In the makai portion the predominant arborescent species is castor bean which grows to about 15' height. Koa-haole 20-30' tall replaces castor bean as the dominant overstory in the mauka sections of the gulch system. In the mauka portion of Hunehune Gulch ivy gourd (Coccinea grandis) is abundant, often completely enshrouding the Guinea grass and koa-haole. Paragrass (Brachiaria mutica), wood rose (Merremia tuberosa),

moon flower (Ipomoeaalba) and peria are also found but only in small to moderate numbers.

(8) Roadside Vegetation (R)

Numerous plant species are found along the paved and gravel roads. More species are found in this community than in any other in the project site. Guinea grass and radiate fingergrass are abundant. 'Uhaloa and nut grass are also found in large numbers and many other species including castor bean, fuzzy rattlepod, buffelgrass, graceful spurge, virgate mimosa, peria, lion's ear (Leonotis nepetifolia), Australian saltbush (Atriplex semibaccata), goosegrass (Eleusine indica), Natal redtop (Rhynchelytrum repens) and stinkgrass (Eragrostis cilianensis) are found in smaller numbers. This is not considered a significant plant community and its total area is very small.

Native Plant Communities

As a result of decades of sugar cultivation, virtually all of the vegetation in the project iste is secondary in nature. Of the 99 plant species recorded two are indigenous ('ilima, pa'uohi'iaka), two are probably indigenous ('uhaloa, hoary abutilon) and one is endemic (ko'oloa'ula, Abutilon menziesii). Of these, 'ilima, 'uhaloa and hoary abutilon are dominant or co-dominant in several plant communities and are significant elements in the vegetation in the site as a whole. Pa'uohi'iaka is found in small to moderate numbers in four vegetation types and is common in certain areas in the Fallowed Fields Mixed Herb community. It frequently grows in association with 'ilima, 'uhaloa and hoary abutilon. They do not, however, represent native plant communities. Rather, these native or possibly native species are well adapted to arid lowlands and are able to recolonize disturbed sites.

Except for ko'oloa'ula, all of the native species in the site are common lowland species in Hawaii. Ko'oloa'ula, on the other hand, is a rare and endangered species once endemic to Lanai, Maui, Oahu and Hawaii. It is now extinct on Hawaii.

Endangered Species

At least 38 individuals of the federally listed endangered species ko'oloa'ula were recorded from the site. Most of these (28) were in the Abandoned Cane Fields, six were in the Fallowed Fields Mixed Herb Association and four were in the Fallowed Fields Grassland Association. Approximate locations are indicated on Figure 2. All of these plants were healthy and most were flowering and/or fruiting.

Ko'oloa'ula was first submitted for listing as an endangered species in 1976 (Fed. Reg. 1976). The Endangered Species Act Amendments of 1978 required that the list of candidates for endangered status be withdrawn after two years and in 1979 ko'oloa'ula was withdrawn from consideration (Fed. Reg. 1979). In 1980 it was resubmitted as a top priority Category 1 candidate (Fed. Reg. 1980) and in 1985 the U.S. Fish and Wildlife Service proposed to list it as an endangered species (Fed. Reg. 1985). On Sept. 26, 1986 it was formally listed (Fed. Reg. 1986) and is now protected under the provisions of the Endangered Species Act of 1973, as amended, and the Hawaii State Revised Statutes.

Significant wild populations of ko'oloa'ula are found on Lanai and Maui but its occurrence on Oahu is somewhat of an enigma. It was known from a single plant discovered in an abandoned sugar cane field mauka of Hawaii Raceway Track at Barbers Point in 1981 and more recently from another individual at the Lualualei Naval Magazine (D. Herbst, pers. comm.). Both of these occurrences as well as the current discovery are from highly disturbed environments. The Barbers Point location is approximately four miles from the project site and the Lualualei site is at least 15 miles away. Ko'oloa'ula was not found in any of the prior surveys in the immediate area (Funk 1990, 1994; Nagata 1994, 1996).

FAUNA

Mammals

No mammals were observed in the site. It is probable, however, that field mice (Mus musculus), mongoose (Herpestris auropunctatus) and one or more species of rats (Rattus spp.) are found in the property. In addition, pig trails were observed in several plant communities.

Birds

Seventeen species of birds were observed in the site. To be considered a sighting, the individual must be observed perched or on the ground and not merely flying overhead. In addition, owl pellets were found in the Fallowed Fields Grassland Association community. It is not known, however, whether these are from the barn owl (Tyto alba) or pueo (Asio flammeus). Fifteen species are introduced, one is a common migratory species (Pacific golden-plover) and one is indigenous (Black-crowned night heron).

ARDEIDAE

Cattle egret (Bubulcus ibid)

Eight individuals were observed in the Abandoned Fields mauka of Farrington

Highway. On 4 October the Abandoned Field community immediately makai of the Cultivated Field east of Palehua Road was being plowed. Nearly 100 cattle egrets were seen feeding in the freshly tilled ground.

Black-crowned night heron (Nycticorax nycticorax)

Two young birds were flushed out of Hunehune Gulch near Plantation Road. As there was no water in either Hunehune Gulch or Kaloi Gulch it is not known whether these individuals are residents of the area or whether they are transients. The black-crowned night heron is indigenous to Hawaii.

CHARADRIIDAE

Pacific golden-plover (Pluvialis dominica)

The Pacific golden-plover is a migratory species which commonly spends its winters in Hawaii. Many were observed in the site. Thirty-two were counted in exposed areas in the Abandoned Cane Fields. Most of these were in the open site near the Ewa boundary. Twenty-six were observed in various areas in the Fallowed Fields Mixed Herb Association - six of them from the exposed areas near the makai boundary road. Twenty-six were seen in the Cultivated Areas. Of these, 20 were in the "parking lot" at the Ewa boundary.

COLUMBIDAE

Rock dove (Columba livia)

Three were observed in the exposed sections of the Fallowed Field Mixed Herb Association in the makai portion of the site.

Barred dove (Geopelia striata)

Many were seen in all but two vegetation types. They were most abundant along the paved roads.

Lace-neck dove (Streptopelia chinensis)

This is the most widespread species in the property. It was found in moderate numbers in all vegetation types.

FRINGILLIDAE

Red-crested cardinal (Paroaria coronata)

Three individuals were seen in koa-haole shrubs along Plantation Road.

Kentucky cardinal (Richmondena cardinalis)

One individual was seen in the Fallowed Fields Mixed Herb Association.

PHASIANIDAE

Francolin (Francolinus sp.)

About a dozen were seen in the Abandoned Cane Fields near Kaloi Gulch in the makai portion of the property. These birds ran and hid too quickly for a positive identification to species.

Ring necked pheasant (Phasianus colchicus)

Three pairs were flushed from the Abandoned Cane Fields and one pair was flushed from the Abandoned Fields along Palehua Road.

PLOCEIDAE

House finch (Carpodacus mexicanus)

About 20 were seen in the property, mostly along the roadways.

Orange-cheeked waxbill (Estrilda melpoda)

These were seen in small numbers in the Fallowed Fields Mixed Herb Association, Abandoned Fields and along the roadways.

Black-headed mannikin (Lonchura malacca)

Black-headed mannikins were seen in moderate numbers in the Abandoned Cane Fields, Fallowed Fields communities and along the roadways.

Rice bird (Lonchura punctulata)

Rice birds were seen in moderate to small numbers in all but two plant communities. They were most common along the roadways and in the Fallowed Fields Grassland Association.

PYCNONOTIDAE

Red-vented bulbul (Pycnonotus cafer)

The red-vented bulbul was the second most widespread species in the site. It was found in small to moderate numbers in all vegetation types except the Cultivated Fields.

STURNIDAE

Common mynah (Acridotheres tristis)

Only three were seen in the Abandoned Cane Fields in the makai portion of the property.

ZOSTEROPIDAE

Japanese white-eye (Zosterops japonicus)

Japanese white-eyes were found in small numbers mostly along the roadways.

SUMMARY

The vegetation in the project site consists of sugar cane, lowland shrubs and herbs and grasses. The vast majority of the 99 species recorded from the property is non-native. Only three native species (one endemic, two indigenous) and two possibly indigenous species were encountered but with the exception of the endemic ko'oloa'ula these were present in moderate to large numbers. Native species constitute a rather significant element of the vegetation. However, no native plant communities are present. As a result of decades of sugar cultvation the vegetation is entirely secondary and the native ('ilima, pa'uohi'iaka) or possibly native (hoary abutilon, 'uhaloa) species which are so common in the site are merely recolonizing an already completely altered habitat. According the the U.S. Fish and Wildlife Service the endangered species ko'oloa'ula can also be included as secondary in origin.

The various plant communities in the site serve as an excellent refuge and feeding site for 17 bird species. Fifteen are introduced urban, field or game birds, one is indigenous (black-crowned night heron) and one is a common migratory species (Pacific golden-plover). Many of the birds including the plover are present in moderate to large numbers.

The proposed project will result in the loss of large numbers of 'ilima, pa'uohi'iaka, 'uhaloa and hoary abutilon. These are all common lowland species and theirs is not considered a significant loss to the native flora. The project will also result in the loss of habitat for a large number of Pacific golden-plovers and two black-crowned night herons. At least 38 individuals of the endangered ko'oloa'ula will be affected by the project. The disposition of these will be determined through consultation with the State of Hawaii Division of Forestry and Wildlife as prescribed by the Hawaii Endangered Species Law.

RECOMMENDATIONS

Because of the presence of the federally endangered ko'oloa'ula in the project site, consultation with the Hawaii State Department of Land and Natural Resources Division of Forestry and Wildlife is required under the provisions of the State Endangered Species Law before any grubbing can commence. Similar discussions with the U.S. Fish and Wildlife Service is also recommended. These consultations will essentially determine the fate of the proposed project and what mitigating measures will be required to preserve the ko'oloa'ula.

The plant survey was conducted at 80% coverage and although a more intensive search was conducted in the vicinity of each ko'oloa'ula there is a high probability that more individuals are present in the site. It is therefor recommended that a 100% survey be undertaken in selected areas as indicated in Figure 2.

LITERATURE CITED

Berger, A.J. 1981. Hawaiian Birdlife. 2nd ed. Univ. Press of Hawaii. Honolulu. 260 pp.

Federal Register. 1976. 41 FR 24523; June 16, 1976.

_____. 1979. 44 FR 70796; December 10, 1979.

_____. 1980. 45 FR 82480; December 15, 1980.

_____. 1985. 50 FR 28876; July 16, 1985.

_____. 1986. 51 FR 34412; September 26, 1986.

Funk, E. 1990. Biological Resources Survey Report for Ewa Villages Development. Prepared for R.M. Towill Corp. 20 pp.

_____. 1994. Biological Resources Survey Report for Schuler Homes East Kapolei Project, East Kapolei, Oahu, Hawaii. Prepared for Schuler Homes, inc. 15 pp.

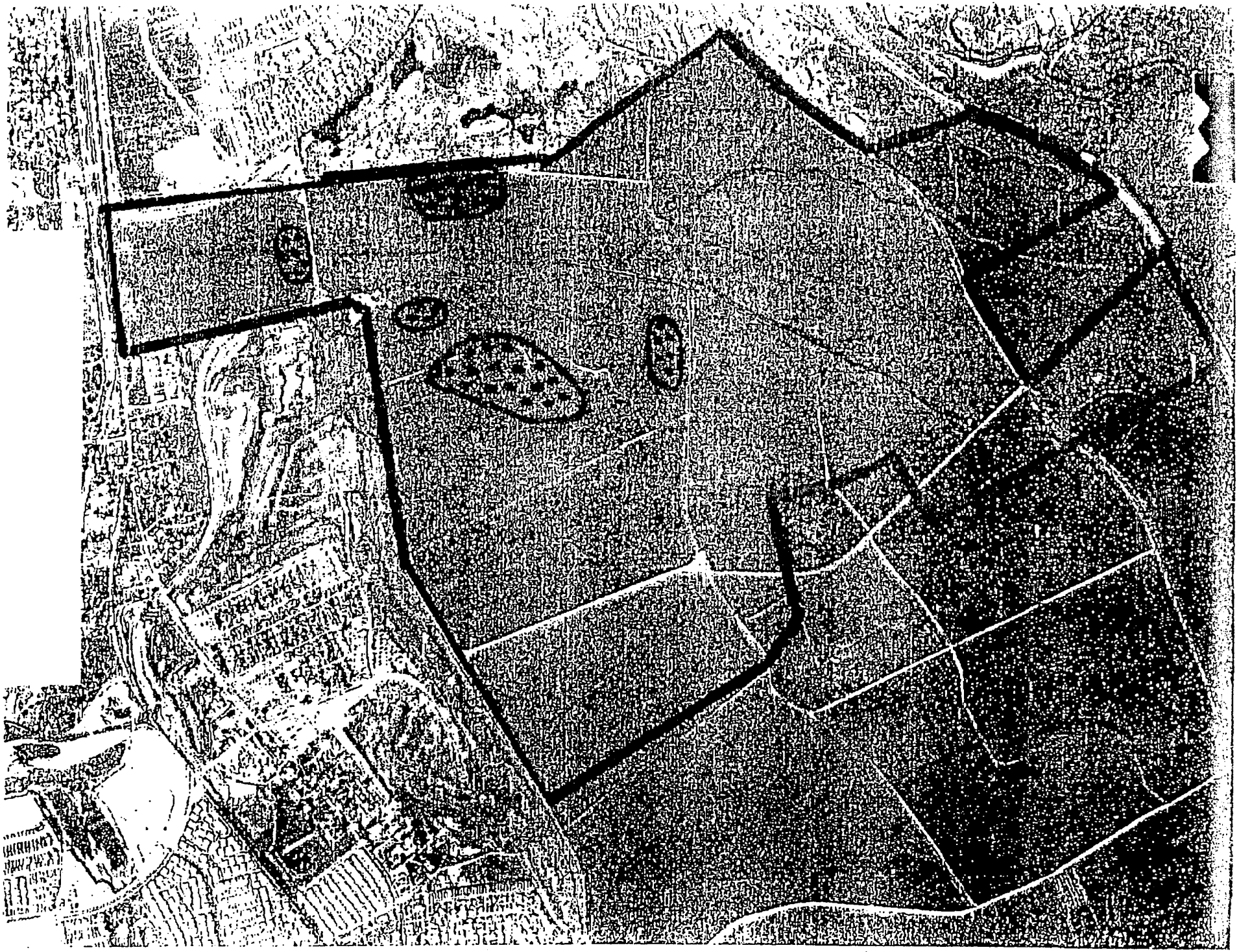
Nagata, K.M. 1994. Kaloi Gulch Vegetation Survey. unpublished. 1 pp.

_____. 1996. Varona Village Biological Survey. Prepared for PBR Hawaii. 14 pp.

Neal, M.C. 1965. In Gardens of Hawaii. Bernice P. Bishop Museum Special Publ. 50. Bishop Museum Press. Honolulu. 924 pp.

St. John, H. 1973. List and Summary of the Flowering Plants in the Hawaiian Islands. Pac. Trop. Bot. Gard. Mem. No 1. Lawai. 579 pp.

Wagner, W.L., D.R. Herbst & S.H. Sohmer. 1990. Manual of the Flowering Plant of Hawaii. 2 vols. Univ. of Hawaii Press & Bishop Museum Press. Honolulu. 1853 pp.



PLANT SPECIES CHECKLIST

Families are arranged alphabetically in two groups: Monocotyledons and Dicotyledons. Genera and species are arranged alphabetically within each family. Taxonomy, common names and status follow those of Neal (1965), St. John (1973) or Wagner et. al. (1990). The abundance determinations are relative and are subject to the judgement of the investigator.

EXPLANATION OF SYMBOLS

Species Status:

- E - Endemic to the Hawaiian Islands, ie. occurring naturally nowhere else in the world.
- I - Indigenous, ie. native to the Hawaiian Islands but also occurring naturally elsewhere.
- X - Exotic (alien), ie. plants introduced after the Western discovery of the islands.
- P - Polynesian introductions, ie. plants introduced before the Western discovery of the islands.

Relative Abundance Ratings:

- A - ABUNDANT, generally the major or dominant species in a given area.
- C - COMMON, generally distributed throughout a given area in large numbers.
- O - OCCASIONAL, generally distributed through a major portion of a given area, but in small numbers.
- U - UNCOMMON, observed uncommonly but more than 10 times in a given area.
- R - RARE, observed 2 to 10 times in a given area.

Vegetation Types:

- ACF - Abandoned Cane Fields
- Fmh - Fallowed Fields Mixed Herb Association
- Fg - Fallowed Fields Grassland Association
- A - Abandoned Fields
- C - Cultivated Fields
- GR - Grasslands
- GU - Gulch Association
- R - Roadside Vegetation

ANIMAL SPECIES CHECKLIST

Families are arranged alphabetically and genera and species are arranged alphabetically within each family. Taxonomy follows that of Berger (1981). Quantitative techniques were not employed and thus only presence is recorded in each vegetation type.

EXPLANATION OF SYMBOLS

Species Status:

M - Migratory species.

I - Indigenous, ie. native to the Hawaiian Islands but also occurring naturally elsewhere.

X - Exotic (alien), ie. animals introduced after the Western discovery of the islands.

Vegetation Types:

ACF - Abandoned Cane Fields

Fmh - Fallowed Fields Mixed Herb Association

Fg - Fallowed Fields Grassland Association

A - Abandoned Fields

C - Cultivated Fields

GR - Grasslands

GU - Gulch Association

R - Roadside Vegetation

CHECK LIST OF PLANTS

SCIENTIFIC NAME	COMMON NAME	STATUS	RELATIVE ABUNDANCE							
CHECKLIST OF PLANTS			ACF	FmH	Fg	A	C	GR	GU	R
MONOCOTYLEDONES										
CYPERACEAE										
Cyperus rotundus L.	Nut grass	X	O	C	O	C	C	–	–	C
POACEAE										
Bothriochloa pertusa (L.) A. Camus	Pitted beardgrass	X	U	U	U	–	–	–	–	U
Brachiaria mutica (Forssk.)Stapf	Paragrass	X	U	U	U	R	–	–	O	U
Cenchrus ciliaris L.	Buffelgrass	X	O	C	–	U	R	U	U	U
Chloris barbata (L.) Sw.	Swollen fingergrass	X	O	O	C	U	–	U	–	C
C. radiata (L.) Sw.	Radiate fingergrass	X	C	C	A	U	–	U	–	A
Cynodon dactylon (L.) Pers.	Bermuda grass	X	–	–	–	R	R	–	–	U
Digitaria insularis (L.) Mez ex Ekman	Sourgrass	X	U	O	O	U	–	–	U	R
Echinochloa crus-galli (L.) P. Beauv.	Barnyard grass	X	U	–	–	–	–	–	–	U
Eleusine indica (L.) Gaertn.	Goosegrass	X	U	U	–	U	–	–	–	U
Eragrostis cilianensis (All.) Link	Stinkgrass	X	R	–	–	R	–	–	–	U
E. tenella (L.) P. Beauv. ex Roem. & Schult.	Japanese lovegrass	X	–	–	–	–	–	–	–	U
Leptochloa uninervia (K. Presl) Hitchc.		X	U	–	–	–	–	–	–	–
Panicum maximum Jacq.	Guinea grass	X	C	O	A	C	U	A	A	A
Rhynchelytrum repens (Willd.) Hubb.	Natal redtop	X	O	O	R	R	R	–	R	O
Saccharum officinarum L.	Sugar cane	X	A	U	U	R	–	–	–	R
Setaria verticillata (L.) P. Beauv.	Bristly foxtail	X	–	–	–	R	–	–	R	–
Sorghum halepense (L.) Pers.	Johnson grass	X	–	–	U	U	–	–	–	U
DICOTYLEDONES										
AMARANTHACEAE										
Achyranthes aspera L.										
Alternanthera caracasana Kunth	Mat charf flower	X	U	–	–	–	–	–	–	R
Amaranthus spinosus L.	Spiny amaranth	X	–	R	–	–	–	–	–	U
A. viridis L.		X	U	O	–	U	R	–	–	R
		X	U	U	–	U	O	–	–	O
ANACARDIACEAE										
Mangifera indica L.	Mango	X	–	–	–	–	–	–	–	R
Schinus terebinthifolius Raddi	Christmas berry	X	–	–	–	–	–	–	–	R
ASCLEPIADACEAE										
Calotropis gigantea (L.) W.T. Aiton	Crown flower	X	–	R	R	–	–	–	–	–
ASTERACEAE										
Bidens pilosa L.	Spanish needle	X	U	–	–	U	–	–	–	U
B. pilosa var. minor (Bl.) Sherff		X	U	–	–	–	–	–	–	–
Conyza bonariensis (L.) Cronq.	Hairy horseweed	X	U	–	–	–	–	–	–	–
Emilia fosbergii Nicolson	Flora's paintbrush	X	O	–	–	–	U	–	–	R
Flaveria trinervia (Spreng.) C. Mohr		X	–	–	–	–	–	–	–	R
Lactuca serriola L.	Prickly lettuce	X	U	u	–	R	–	–	–	–
Pluchea indica (L.) Less.	Indian fleabane	X	U	U	U	–	–	–	–	U
P. x fosbergii Cooperr. & Galang		X	–	U	R	–	–	–	–	–
P. symphytifolia (Mill.) Gillis	Sourbush	X	U	U	U	–	–	–	–	U
Sonchus asper (L.) J. Hill	Prickly sow thistle	X	R	–	–	–	–	–	–	–

CHECK LIST OF PLANTS

SCIENTIFIC NAME	COMMON NAME	STATUS	RELATIVE ABUNDANCE							
			ACF	Fmh	Fg	A	C	GR	GU	R
ASTERACEAE										
Sonchus oleraceus L.	Sow thistle	X	R	–	–	–	U	–	–	–
Tridax procumbens L.	Coat buttons	X	U	C	U	U	U	–	–	U
Verbesina encelioides (Cav.) Benth. & Hook.	Golden crown-beard	X	U	C	–	U	R	–	–	U
Xanthium strumarium L.	Cocklebur	X	R	–	–	–	R	–	–	U
BIGNONIACEAE										
Spathodea campanulata Beauv.	African tulip	X	R	R	–	–	–	–	–	–
BORAGINACEAE										
Heliotropium procumbens var. depressum (Cham.) Fosb.		X	–	–	–	–	–	U	–	U
CAPPARADACEAE										
Cleome gynandra L.	Wild spider flower	X	–	–	–	–	R	–	–	–
CHENOPODIACEAE										
Atriplex semibaccata R. Br.	Australian saltbush	X	–	–	–	R	–	–	–	O
X. suberecta Verd.		X	U	U	–	–	–	–	–	O
CONVOLVULACEAE										
Convolvulus arvensis L.	Field bindweed	X	U	U	–	–	U	–	–	O
Ipomoea alba L.	Moon flower	X	–	–	–	–	–	–	U	–
I. cairica (L.) Sweet	Koali	X?	–	R	–	–	–	–	–	–
I. obscura (L.) Ker-Gawl		x	U	U	–	–	–	–	–	O
I. triloba L.	Little bell	X	O	U	U	A	A	–	–	O
Jacquemontia ovalifolia (Choisy) H. Hallier	Pa'uohi'iaka	I	U	O	U	–	–	–	–	U
Merremia aegyptia (L.) Urb.	Hairy merremia	X?	U	O	–	U	U	–	–	–
M. tuberosa (L.) Rendle	Wood rose	X	–	–	–	–	–	–	R	–
CUCURBITACEAE										
Citrellus lanatus (Thunb.) Matsum. & Nakai	Watermelon	X	–	–	–	–	U	–	–	–
Coccinea grandis (L.) Voigt	Ivy gourd	X	O	U	U	U	U	R	A	U
Cucumis dipsaceus Ehrenb. ex Spach	Teasel gourd	X	–	R	–	–	–	–	–	–
Momordica charantia L. var. abbreviata	Peria	X	O	O	U	O	C	–	U	O
EUPHORBIACEAE										
Chamaesyce hirta (L.) Millsp.	Garden spurge	X	–	R	R	–	U	U	–	O
C. hypericifolia (L.) Millsp.	Graceful spurge	X	O	U	U	O	O	–	–	O
C. hyssopifolia (L.) Small		X	–	–	R	R	–	–	–	U
Euphorbia cyathophora J.A. Murray	Mexican fire plant	X	–	–	–	–	–	–	–	R
E. heterophylla L.	Kaliko	X	–	–	–	U	U	–	–	–
Ricinus communis L.	Castor bean	X	U	–	U	U	O	–	C	O
FABACEAE										
Acacia farnesiana (L.) Willd.	Klu	X	–	–	R	R	–	O	R	R
Cassia sp.		X	–	U	–	–	–	–	–	–
Chamaecrista nictitans (L.) Moench	Japanese tea	X	–	–	–	–	R	–	–	R
Crotalaria incana L.	Fuzzy rattlepod	X	O	U	O	C	O	U	–	O
C. pallida Aiton	Smooth rattlepod	X	R	R	U	–	–	–	–	U
Desmanthus virgatus (L.) Willd.	Virgate mimosa	X	U	O	U	U	–	U	–	O

CHECK LIST OF PLANTS

SCIENTIFIC NAME	COMMON NAME	STATUS		RELATIVE ABUNDANCE							
				ACF	Fmh	Fg	A	C	GR	GU	R
FABACEAE											
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	X		–	–	–	–	–	–	–	U
Erythrina sp.		X		–	–	–	–	–	–	R	R
Indigofera spicata Forssk.	Creeping indigo	X		–	–	–	–	–	–	–	U
I. suffruticosa Mill.	Indigo	X		U	U	U	R	–	–	–	U
Lablab purpureus (L.) Sweet	Hyacinth bean	X		R	R	–	–	–	–	–	U
Leucaena leucocephala (Lam.) de Wit	Koa-haole	X		U	U	U	U	–	O	A	U
Macroptilium lathyroides (L.) Urban	Cow pea	X		U	U	–	–	U	–	–	R
Pithecellobium dulce (Roxb.) Benth.	'Opiuma	X		R	R	–	–	–	–	–	R
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	Kiawe	X		–	R	–	–	–	R	–	U
Senna occidentalis (L.) Link	Coffee senna	X		–	R	–	–	–	–	–	–
Vigna sesquipedalis Wight	Long bean	X		R	–	–	–	–	–	–	–
LAMIACEAE											
Leonotis nepetifolia (L.) R. Br.	Lion's ear	X		O	U	R	U	U	U	–	U
MALVACEAE											
Abutilon grandifolium (Willd.) Sweet	Hairy abutilon	X		–	–	–	–	–	U	–	U
A. incanum (Link) Sweet	Hoary abutilon	I?		C	C	C	O	R	U	–	–
A. menziesii Seem.	Ko'oloa'ula	E	ENDANGERED	U	R	–	–	–	–	–	–
Malvastrum coromandelianum (L.) Garcke	False mallow	X		O	C	O	O	C	U	–	O
Sida ciliaris L.		X		–	–	–	–	–	–	–	U
S. fallax Walp.	'Ilima	I		C	A	C	U	–	U	–	R
S. rhombifolia L.	Cuba jute	X		–	U	–	–	–	–	–	U
S. spinosa L.	Prickly sida	X		–	U	–	R	–	U	–	U
MORACEAE											
Morus sp.		X		R	–	–	–	–	–	–	–
NYCTAGINACEAE											
Boerhavia coccinea Mill.		X		O	O	R	U	U	U	–	U
PASSIFLORACEAE											
Passiflora foetida L.	Love-in-a-mist	X		U	–	U	O	R	U	–	U
PORTULACACEAE											
Portulaca oleracea L.	Pigweed	X		U	U	U	R	U	U	–	–
PRIMULACEAE											
Anagallis arvensis L.	Scarlet pimpernel	X		R	–	–	–	–	–	–	–
SOLANACEAE											
Datura stramonium L.	Jimson weed	X		–	–	–	–	–	–	R	–
Lycopersicon pimpinellifolium Mill.	Currant tomato	X		U	R	–	U	O	–	–	U
Nicotiana glauca R.C. Graham	Tree tobacco	X		U	R	R	–	–	–	–	U
STERCULIACEAE											
Waltheria indica L.	'Uhaloa	I?		C	A	O	C	O	U	–	C

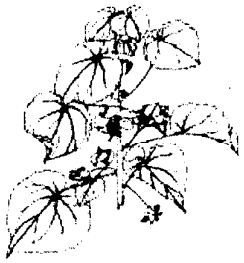
CHECK LIST OF PLANTS

SCIENTIFIC NAME	COMMON NAME	STATUS			RELATIVE ABUNDANCE								
					ACF	Fmh	Fg	A	C	GR	GU	R	
TILIACEAE													
Triumfetta semitriloba Jacq.	Sacramento bur	X			–	–	–	–	–	–	–	R	
ZYGOPHYLLACEAE													
TRIBULUS TERRESTRIS L.	Puncture vine	X			–	R	–	–	R	–	–	O	

CHECK LIST OF PLANTS

SCIENTIFIC NAME	COMMON NAME	STATUS	RELATIVE ABUNDANCE							
CHECKLIST OF ANIMALS			ACF	Fmh	Fg	A	C	GR	GU	R
ARDEIDAE										
Bubulcus ibid	Cattle egret	Y	–	–	–	X	X	–	–	–
Nycticorax nycticorax	Black-crowned night heron	I	–	–	–	–	–	–	–	X
CHARADRIIDAE										
Pluvialis dominica	Pacific golden-plover	M	X	X	–	–	X	–	–	–
COLUMBIDAE										
Columba livia	Rock dove	X	–	X	–	–	–	–	–	–
Geopelia striata	Barred dove	X	X	X	X	X	X	–	–	X
Streptopelia chinensis	Lace-neck dove	X	X	X	X	X	X	X	X	X
FRINGILLIDAE										
Paroaria coronata	Red-crested cardinal	X	–	–	–	–	–	–	–	X
Richmondena cardinalis	Kentucky cardinal	X	–	X	–	–	–	–	–	–
PHASIANIDAE										
Francolinus sp.	Francolin	Y	Y	–	–	–	–	–	–	–
Phasianus colchicus	Ring-necked pheasant	X	X	–	–	X	–	–	–	–
PLOCEIDAE										
Carpodacus mexicanus	House finch	Y	Y	–	–	–	–	–	–	X
Estrilda melpoda	Orange-cheeked waxbill	X	–	X	–	X	–	–	–	X
Lonchura malacca	Black-headed mannikin	X	X	X	X	–	–	–	–	X
L. punctulata	Rice bird	Y	X	X	X	X	–	X	–	X
PYCNONOTIDAE										
Pycnonotus cafer	Red-vented bulbul	X	Y	Y	Y	Y	–	X	X	X
STURNIDAE										
Acridotheres tristis	Common mynah	Y	X	–	–	–	–	–	–	–
ZOSTEROPIDAE										
Zosterops japonicus	Japanese white-eye	X	Y	Y	–	–	–	–	–	X

Appendix B
Botanical Survey
W. Char
(January 1997)



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January 1997

SUMMARY OF FINDINGS
KO'OLOA'ULA ON EAST KAPOLEI PROJECT SITE
'EWA DISTRICT, ISLAND OF O'AHU

INTRODUCTION

The ko'oloa'ula (Abutilon menziesii), a member of the hibiscus or mallow family (Malvaceae), is a much-branched shrub up to 6 to 9 ft. tall, which is covered by velvety, stellate pubescence. The heart-shaped leaves are silvery-green and the attractive flowers are maroon. It is uncommon and occurs in dryland habitats (Wagner et al. 1990). Today, the largest population is found on Lana'i (about 600 plants) in koa haole scrub. Five small populations occur on Maui on 'a'a lava and also on red soils in a large gulch adjacent to sugar cane fields. One population occurs at Puako on the island of Hawai'i. On O'ahu, a single plant was found in abandoned sugar cane fields near the Campbell Industrial Park. Recently, a single plant was found on the Navy's Lualualei facility in kiawe/Guinea grass scrub.

In 1986, the species was federally listed as endangered. All plants on the federal list are automatically added to the state endangered species list. In its natural habitat the ko'oloa'ula plants are threatened by browsing animals (cattle, goats, axis deer), competition from weedy introduced plants, fires, predation by introduced insects, loss of native pollinators, and development (U.S. Fish and Wildlife Service 1994).

Because the plant is attractive and is easy to cultivate (seeds and cuttings), it was once sold by several plant nurseries as "red 'ilima" prior to its listing.

A new populaion of the ko'oloa'ula was recently discovered by Nagata while conducting a survey of the HFDC's East Kapolei project site in September and October 1996. Nagata recorded at least 38 ko'oloa'ula plants from the southwest corner of the project site (Figure 1). Collections of the plants were deposited by Nagata at the Bishop Museum.

A survey to verify and to more accurately inventory and map the plants found by Nagata was conducted in December 1996. This survey followed an unusually heavy rainfall in November 1996 which lasted for about 10 days.

RESULTS

Three colonies of plants were identified in the field and mapped (Figure 2). We could not locate the northern-most colony mapped by Nagata.

Colony A: This colony consists of 6 large, mature (flowering/budding) plants, 2 to 6 ft. tall, and 2 juvenile (young, immature) plants, 1 to 1.5 ft. tall.

Colony B: This colony is found along the golf course fence. About half (11 plants) are composed of juvenile plants, most of which have probably sprouted and grown since the November rains. The remaining plants (10) are mature individuals.

Colony C: This is the largest colony and is found near the power

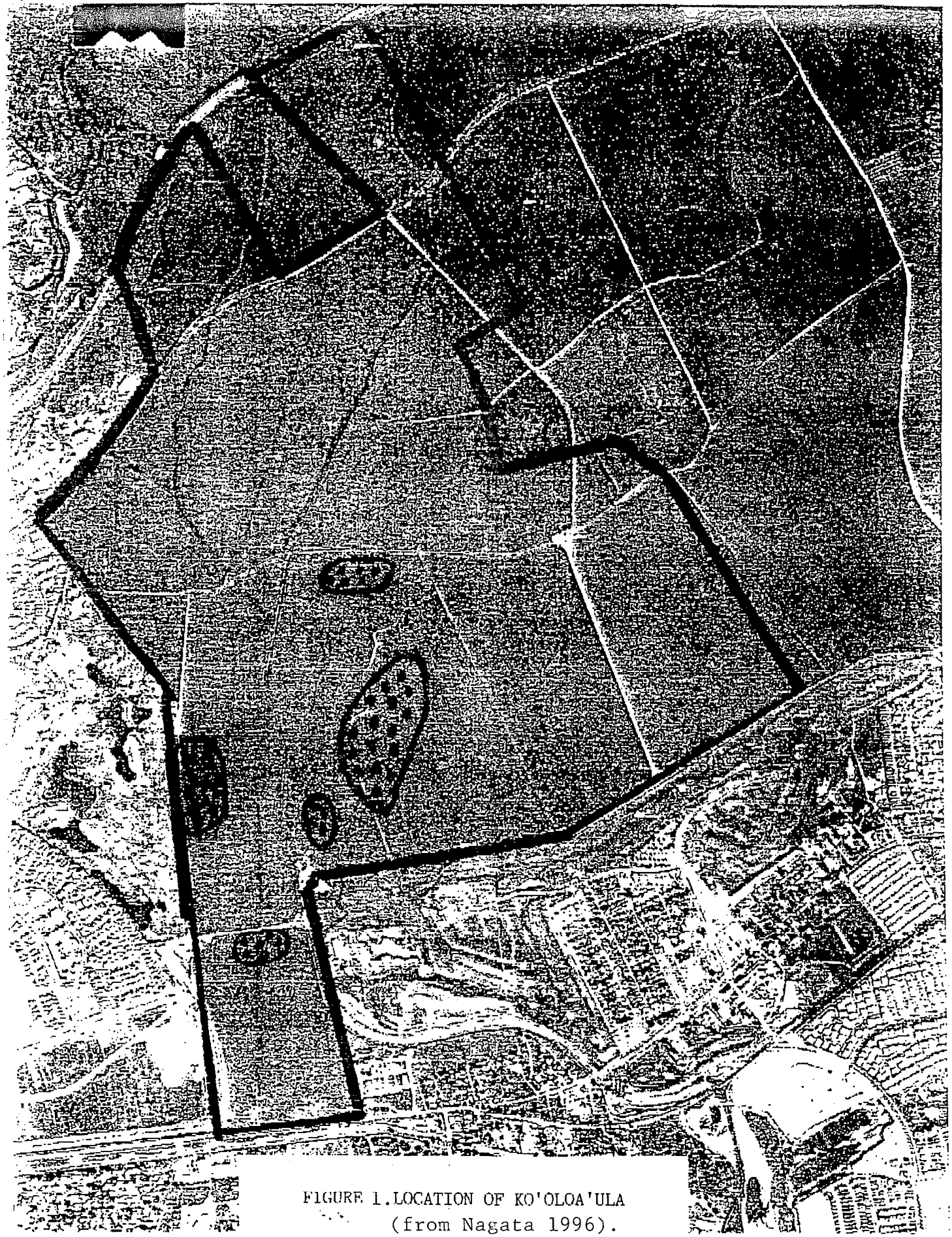

FIGURE 1. LOCATION OF KO'OLOA'ULA (from Nagata 1996).

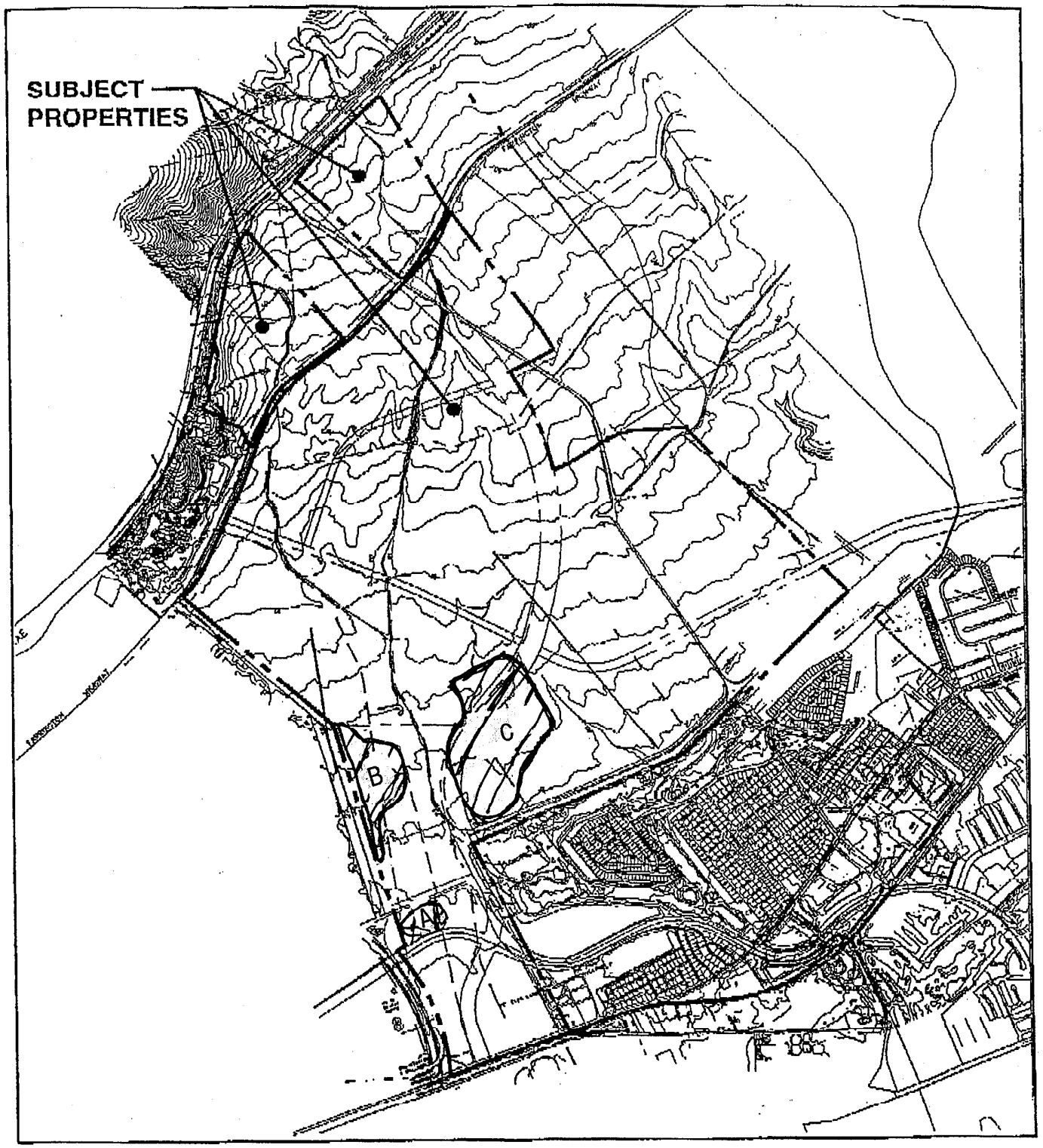

FIGURE 2

LOCATION OF KO'OLOA'ULA DURING THIS SURVEY.

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February, 1997

PBR HAWAII

line. Nagata maps it as two separate colonies. But after the more intensive survey, we located plants between the two colonies and have thus lumped them into one larger colony. The majority of the plants are centered around an overgrown, coral-lined cane haul road. A few plants cross under the power line and extend north of the power line for a short distance. The colony consists of 55 large, mature plants (many of them 4 to 6 ft. tall), and 4 juvenile plants.

DISCUSSION AND RECOMMENDATIONS

A total of 88 ko'oloa'ula plants were found during the recent study to flag and inventory the plants on the East Kapolei site. There are a large number of juvenile plants, most of which sprouted and established themselves since the unusually heavy rainfall in November 1996. The number of plants will most likely increase during this rainy season (November 1996 to about February 1997).

It is recommended that a mitigation plan be initiated as soon as possible as the mature plants will continue to set seeds and the colonies will continue to expand in area.

The larger plants can be easily cultivated from seeds and cuttings while the smaller plants can be dug up and transplanted. It is recommended that an area be set aside for the conservation of these plants. An excellent location would be within the power line corridor. A greenway or belt of vegetation with the ko'oloa-'ula could be established here. A few plants already occur within this corridor.

References

U.S. Fish and Wildlife Service. 1994. Lana'i plant cluster recovery plan: Abutilon eremitopetalum, Abutilon menziesii, Cyanea macrostegia ssp. gibsonii, Cyrtandra munroi, Gahnia lanaiensis, Phyllostegia glabra var. lanaiensis, Santalum freycinetianum var. lanaiensis, Tetramolopium remyii, and Viola lanaiensis. Portland, Or.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1990. Manual of the flowering plants of Hawai'i. 2 vols. University of Hawai'i Press and B.P. Bishop Museum Press, Honolulu. B.P. Bishop Museum Special Publication 83.

Appendix C
Botanical Survey
W. Char
(October 1997)

BOTANICAL RESOURCES STUDY
NORTH-SOUTH ROAD CORRIDOR
(H-1 FREEWAY TO KAPOLEI PARKWAY)
'EWA DISTRICT, ISLAND OF O'AHU

by

Winona P. Char

CHAR & ASSOCIATES
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Prepared for:

PARSONS BRINCKERHOFF

October 1997

BOTANICAL RESOURCES STUDY
NORTH-SOUTH ROAD CORRIDOR
(H-1 FREEWAY TO KAPOLEI PARKWAY)
'EWA DISTRICT, ISLAND OF O'AHU

INTRODUCTION

The botanical resources found on the North-South road corridor from its proposed interchange with Interstate Route H-1 to its terminus at the proposed Kapolei Parkway is presented in this report. The majority of the alignment crosses sugar cane fields which are no longer in cultivation. Although sugar cane cultivation ceased two to three years ago, there are still a few remnant clumps of sugar cane in the area between Farrington Highway and Waimanalo Road. However, in most places the former fields are now overgrown with Guinea grass or mixed scrub vegetation. A narrow band of koa haole scrub can be found along old irrigation ditches, drainageways, and roadways.

A reconnaissance-level field study was conducted in June 1996, and later in December 1996 during the rainy season. The primary objectives of the field studies were to:

1) provide a description of the vegetation found on the undeveloped portions of the corridor;
2) inventory the flora;
3) search for threatened and endangered plants as well as species of concern; and
4) identify areas of potential environmental problems or concerns and propose appropriate mitigation measures.

One Federal and State listed endangered species, the ko'oloa'ula

(Abutilon menziesii), was found during the field studies and is discussed in more detail in the "Endangered Plants" section of the report.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. The roadway alignment maps and a recent colored aerial photograph of the study area were examined to determine vegetation cover patterns, terrain characteristics, access, boundaries, and reference points.

A walk-through survey method was used. Notes were made on plant distributions and associations, substrate types, drainage, topography, exposure, etc. Plant identifications were made in the field; plants which could not be positively identified were collected for later determination in the herbarium (University of Hawai'i, Manoa - HAW), and for comparison with the recent taxonomic literature.

The species recorded during the field studies are indicative of the season ("rainy" vs. "dry") and the environmental conditions at the time of the studies. A survey taken at a different time of the year and under varying environmental conditions would no doubt yield slight variations in the species list, especially of the weedy, annual taxa.

DESCRIPTION OF THE VEGETATION

In the U.S. Fish and Wildlife Service sponsored 'Ewa Plains' Botanical Survey (Char and Balakrishnan 1979), the vegetation along the roadway corridor was mapped as "C", sugar cane fields.

On areas which were not actively cultivated, koa haole shrubland and mixed grass-shrubland were found. Since that survey, O'ahu Sugar Company, Ltd., has ceased cultivating the fields, and much of the 'Ewa Plains has been developed for the second city of Kapolei.

In the discussion below, the vegetation along the proposed North-South road corridor is described from mauka to makai, that is, from its proposed interchange with Interstate Route H-1 to its makai terminus at Kapolei Parkway. Locations are referenced to existing roads and landmarks as the corridor had not been flagged and staked at the time of the field studies. A checklist of all those plants inventoried during the field work is presented at the end of the report.

Vegetation along the corridor

At the interchange with H-1, dense koa haole shrubs (Leucaena leucocephala) border the highway and cover the southwest portion of the interchange. Clumps of Guinea grass (Panicum maximum), 3 to 5 ft. tall, form a thick cover between the shrubs. Scattered through this koa haole/Guinea grass scrub are trees of kiawe (Prosopis pallida) and 'opiuma (Pithecellobium dulce). Along Kalo'i Gulch, there are a few Java plum (Syzygium cumini) and kukui (Aleurites moluccana) trees among the koa haole thickets. Upslope of the highway are former sugar cane fields now overgrown with Guinea grass and buffel grass (Cenchrus ciliaris).

Between Interstate Route H-1 and Farrington Highway, the former sugar cane fields are now overgrown with buffel grass. A few clumps of the taller Guinea grass can be seen scattered here and there. Koa haole shrubs and a few kiawe trees line the edges of the grassy fields. A few of the fields had been planted earlier

with other crops such as watermelons, but in December these fields were overgrown with low mats of pink bindweed (Ipomoea triloba) and clumps of other weedy species such as cocklebur (Xanthium strumarium), apple of Peru (Nicandra physalodes), kaliko (Euphorbia heterophylla), etc.

On the State-owned lands between Farrington Highway and Waimanalo Road, the cane fields were the most recently fallowed and so there are still a few areas with remnant clumps of sugar cane plants (Saccharum officinarum), from 5 to 7 ft. tall. Where the plants collect runoff water in low lying areas, the sugar cane cover is somewhat dense. Where the soil is drier and cracked, there are only dead, dried out clumps of cane. The abandoned fields have been invaded by a mixed scrub composed of swollen fingergrass (Chloris barbata) and a number of other weedy species which include 'uhaloa (Waltheria indica), 'ilima (Sida fallax), hoary abutilon (Abutilon incanum), currant tomato (Lycopersicon pimpinellifolium), Guinea grass, lion's ear (Leonotis nepetifolia), coat buttons (Tridax procumbens), pink bindweed, castor bean (Ricinus communis), etc. In some places, Guinea grass has formed a dense cover, 3 to 6 ft. tall, with only a few other species present. Kalo'i and Makakilo Gulches, now reduced to somewhat narrow drainage channels, support koa haole shrubs and thick tangles of ivy gourd vine (Coccinia grandis).

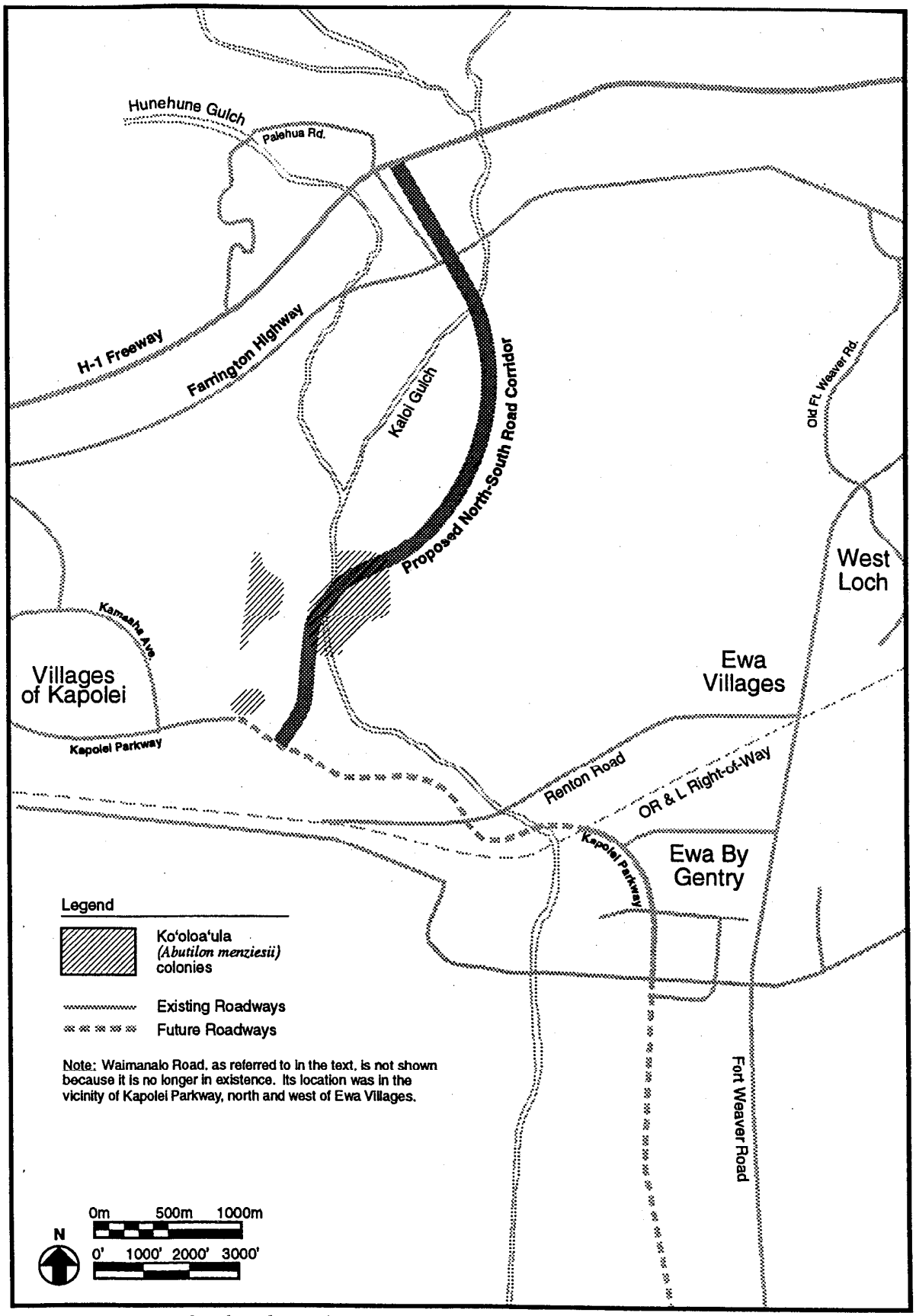
ENDANGERED PLANTS

Because the 'Ewa Plains have been extensively disturbed by agricultural activities for such a long period of time, there are few places which support native plant communities. The few places with native plants tend to be found on areas with karst or limestone topography; since these areas do not have soil they were unsuitable for agriculture. Two listed endangered species which occur today in such habitats are the 'Ewa Plains 'akoko (Chamaesyce

skottsbergii) and Achyranthes rotundata. Both are found only on limestone sites within Campbell Industrial Park and Barbers Point Naval Air Station (Char and Balakrishnan 1979; Traverse Group, Inc., 1988). One plant of the endangered ko'oloa'ula (Abutilon menziesii) was found in an overgrown sugar cane field near Kalaeloa Boulevard in the industrial park (Char and Balakrishnan 1979; Wagner et al. 1990; U.S. Fish and Wildlife Service 1994). There are historical records of two listed endangered species, the 'awiwi (Centaurium sebaeoides) and 'ihi'ihi (Marsilea villosa), and two species of concern, the 'ihi (Portulaca villosa) and pu'uka'a (Torulinium odoratum ssp. auriculatum), in the vicinity of the proposed corridor (B. Harper, USFWS, 01 February 1996 letter).

During the field studies for the State Housing Finance and Development Corporation's (HFDC) East Kapolei project, in September and October 1996, 38 plants of the endangered ko'oloa'ula were found by Ken Nagata, botanist, on the southwest corner of the HFDC project site. The plants occur primarily in mixed scrub and also in areas with remnant clumps of sugar cane. A survey to verify the findings and to more accurately inventory and map the plants was conducted in December 1996 (Char 1997). This December survey followed an unusually heavy period of rainfall in November 1996 in which the 'Ewa area received more than 20 inches of rainfall in about 10 days; average rainfall for the 'Ewa area is 20 inches per year.

A total of 88 ko'oloa'ula plants were flagged and inventoried; the plants occur in three colonies, located fairly close to each other. A large number of juvenile plants which had sprouted after the November rains were found. Some of the ko'oloa'ula plants lie within the proposed North-South road corridor where it follows near the existing HECO powerline (Figure 1).



Distribution of the Endangered Plant Ko'oloa'ula (Abutilon menziesii)
NORTH-SOUTH ROAD CORRIDOR STUDY
Botanical Survey Report
FIGURE 1

DISCUSSION AND RECOMMENDATIONS

The majority of the proposed North-South Road corridor will cross over former sugar cane fields now overgrown with weedy scrub and scattered koa haole thickets. These areas have little of botanical interest as they have been disturbed (under cultivation) for a long period of time and are dominated by introduced or alien plant species. The only area of concern is that portion of the corridor which will cross through the endangered ko'oloa'ula population.

A mitigation plan which would relocate the affected ko'oloa'ula plants is being prepared.

LITERATURE CITED

Char, W.P. 1997. Summary of findings, Ko'oloa'ula on East Kapolei project site, 'Ewa District, island of O'ahu. Prepared for PBR Hawai'i. January 1997.

Char, W.P. and N. Balakrishnan. 1979. 'Ewa Plains Botanical Survey. U.S. Fish and Wildlife Service. Contract No. 14-16-0001-78171. 119 pp. + maps.

Traverse Group, Inc. 1988. Natural resources management plan, Naval Air Station, Barbers Point. Prepared for Pacific Division, Naval Facilities Engineering Command. Contract No. N6274-86-C-0538.

U.S. Fish and Wildlife Service. 1995. Lana'i plant cluster recovery plan: Abutilon eremitopetalum, Abutilon menziesii, Cyanea macrostegia ssp. gibsonii, Cyrtandra munroi, Gahnia lanaiensis, Phyllostegia glabra var. lanaiensis, Santalum freycinetianum var. lanaiensis, Tetramolopium remyi, and Viola lanaiensis. U.S. Fish and Wildlife Service, Portland, OR. 138 pp. September 1995.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1990. Manual of the flowering plants of Hawai'i. 2 vols. University of Hawai'i Press and B.P. Bishop Museum Press, Honolulu. B.P. Bishop Museum Special Publication 83.

Wagner, W.L. and D.R. Herbst. 1995. Contributions to the Flora of Hawai'i. IV. New Records and Name Changes. Bishop Museum Occasional Papers 42: 13-27.

SPECIES LIST -- North-South Road Corridor (H-1 Freeway to Kapolei Parkway)

The following checklist is an inventory of the plants observed on the undeveloped lands within the proposed roadway corridor. The plants are arranged alphabetically by families within each of two groups: Dicots and Monocots. The taxonomy and nomenclature of the flowering plants follow the most recent treatment of the Hawaiian flora by Wagner et al. (1990) and new additions to the flora in Wagner and Herbst (1995).

The following information is provided for each species:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name(s), when known.
3. Biogeographic status. The following symbols are used:
   - E = endemic = native only to the Hawaiian Islands.
   - I = indigenous = native to the Hawaiian Islands and also elsewhere throughout the Pacific and/or tropics.
   - I? = questionably indigenous = data not clear if introduced or if arrival here by natural means, but weight of evidence suggests probably indigenous.
   - P = Polynesian = plants originally of Polynesian introduction prior to Western contact (Cook's discovery of the islands in 1778).
   - X = introduced or alien = all those plants brought to the islands by humans, intentionally or accidentally, after Western contact (1778).
   - X? = questionably introduced = dates of introduction unclear or very early, may be indigenous or of Polynesian introduction.

Scientific name	Common name	Status
DICOTS		
ACANTHACEAE (Acanthus family)		
Asystasia gangetica (L.) T. Anders.	Chinese violet	X
AIZOACEAE (Fir-marigold family)		
Trianthema portulacastrum L.		X
AMARANTHACEAE (Amaranthus family)		
Achyranthes aspera L.		X
Amaranthus spinosus L.	spiny amaranth, pakai kuku	X
Amaranthus viridis L.	slender amaranth, pakai	X
ANACARDIACEAE (Mango family)		
Schinus terebinthifolius Raddi	Christmas berry	X
ASCLEPIADACEAE (Milkweed family)		
Calotropis procera (Aiton) W.T. Aiton	blue crown flower	X
ASTERACEAE (Daisy family)		
Bidens pilosa L.	Spanish needle, beggars tick, ki	X
Conyza bonariensis (L.) Cronq.	hairy horseweed, 'ilioha	X
Emilia fosbergii Nicolson	Flora's paintbrush, red pualele	X
Pluchea indica (L.) Less.	Indian pluchea	X
Pluchea carolinensis (Jacq.) G. Don	pluchea, sourbush	X
Sonchus oleraceus L.	common sowthistle, pua-lele	X
Tridax procumbens L.	coat buttons	X
Verbesina encelioides (Cav.) Benth. & Hook.	golden crownbeard	X
Vernonia cinerea (L.) Less.	little ironweed	X
Xanthium strumarium var. canadense (Mill.) Torr. & A. Gray	cocklebur, kikania	X
BIGNONIACEAE (Bignonia family)		
Spathodea campanulata P. Beauv.	African tulip tree	X
CHENOPODIACEAE (Goosefoot family)		
Atriplex suberecta Verd.	saltbush	X
Chenopodium murale L.	'aheahea	X

Scientific name	Common name	Status
CONVOLVULACEAE (Morning-glory family)		
Ipomoea obscura (L.) Ker-Gawl.	field bindweed	X
Ipomoea triloba L.	pink bindweed, little bell	X
Merremia aegyptia (L.) Urb.	hairy merremia, koali kua hulu, kuahulu	X?
CUCURBITACEAE (Gourd family)		
Coccinia grandis (L.) Voigt	ivy gourd, scarlet-fruited gourd	X
Momordica charantia L.	wild bittermelon	X
EUPHORBIACEAE (Spurge family)		
Aleurites moluccana (L.) Willd.	kukui, tutui	P
Chamaesyce hirta (L.) Millsp.	hairy spurge	X
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	X
Chamaesyce prostrata (Ait.) Small	prostrate spurge	X
Euphorbia heterophylla L.	kaliko	X
Phyllanthus debilis Klein ex Willd.	niruri	X
Ricinus communis L.	castor bean, pa'aila, koli	X
FABACEAE (Pea family)		
Crotalaria incana L.	fuzzy rattlepod, kukae-hoki	X
Crotalaria pallida Aiton	smooth rattlepod, pika-kani	X
Desmanthus virgatus (L.) Willd.	slender mimosa	X
Indigofera suffruticosa Mill.	indigo, 'iniko	X
Indigofera spicata Forssk.	creeping indigo	X
Leucaena leucocephala (Lam.) de Wit	koa haole	X
Macroptilium lathyroides (L.) Urb.	wild bean, cow pea	X
Phaseolus sp.		X
Pithecellobium dulce (Roxb.) Benth.	'opiuma	X
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	kiawe	X
Senna pendula (Humb. & Bonpl. ex Willd.) H. Irwin & Barneby	senna	X
LAMIACEAE (Mint family)		
Leonotis nepetifolia (L.) R. Br.	lion's ear	X
MALVACEAE (Mallow family)		
Abutilon grandifolium (Willd.) Sweet	hairy abutilon, ma'o	X
Abutilon incanum (Link) Sweet	ma'o, hoary abutilon	I?

Scientific name	Common name	Status
Abutilon menziesii Seem.	ko'oloa'ula	E
Malvastrum coromandelianum (L.) Garcke	false mallow	X
Sida fallax Walp.	'ilima	I
Sida rhombifolia L.		X
MYRTACEAE (Myrtle family)		
Syzygium cumini (L.) Skeels	Java plum	X
NYCTAGINACEAE (Four-o'clock family)		
Boerhavia coccinea Mill.	red-flowered boerhavia	X
PASSIFLORACEAE (Passion flower family)		
Passiflora foetida L.	running pop, pohapoha	X
PORTULACACEAE (Purslane family)		
Portulaca oleracea L.	pigweed, 'akulikuli kula	X
SOLANACEAE (Nightshade family)		
Lycopersicon pimpinellifolium (Jusl.) Mill.	currant tomato	X
Nicandra physalodes (L.) Gaertn.	apple of Peru	X
Nicotiana glauca R.C. Graham	tree tobacco, paka	X
Solanum americanum Mill.	glossy nightshade, popolo, 'olohua	I?
STERCULIACEAE (Cacao family)		
Waltheria indica L.	'uhaloa, hi'aloa, kanakaloa	I?
ZYGOPHYLLACEAE (Creosote bush family)		
Tribulus terrestris L.	puncture vine, goat head	X
MONOCOTS		
COMMELINACEAE (Dayflower family)		
Commelina benghalensis L.	hairy honohono	X
CYPERACEAE (Sedge family)		
Cyperus rotundus L.	nut sedge, nutgrass	X
POACEAE (Grass family)		
Bothriochloa pertusa (L.) A. Camus	pitted beardgrass	X
Brachiaria mutica (Forssk.) Stapf	California grass	X

Scientific name	Common name	Status
Brachiaria subquadriparia (Trin.) Hitchc.		X
Cenchrus ciliaris L.	buffel grass	X
Cenchrus echinatus L.	common sandbur, 'ume'alu, mau'u kuku	X
Chloris barbata (L.) Sw.	swollen fingergrass, mau'u lei	X
Chloris radiata (L.) Sw.	plush grass	X
Cynodon dactylon (L.) Pers.	Bermuda grass, manienie	X
Dactyloctenium aegyptium (L.) Willd.	beach wiregrass	X
Digitaria insularis (L.) Mez. ex Ekman	sourgrass	X
Eleusine indica Gaertn.	goose grass, wire grass	X
Leptochloa uninervia (Presl.) Hitchc. & Chase	leptochloa	X
Melinis repens (Willd.) Zizka	Natal redtop, Natal grass	X
Panicum maximum Jacq.	Guinea grass	X
Panicum maximum var. trichoglume Eyles ex Robyns	green panicgrass	X
Saccharum officinarum L.	sugar cane, ko	X
Setaria verticillata (L.) Beauv.	bristly foxtail	X
Sorghum halepense (L.) Pers.	Johnson grass	X

Appendix D
Botanical Survey
W. Char
(August 2003)

BOTANICAL SURVEY
UNIVERSITY OF HAWAI'I WEST O'AHU
EAST KAPOLEI, 'EWA DISTRICT, O'AHU

by

CHAR & ASSOCIATES
Botanical Consulants
Honolulu, Hawai'i

Prepared for: **PBR HAWAII**

August 2003

BOTANICAL SURVEY
UNIVERSITY OF HAWAI'I WEST O'AHU
EAST KAPOLEI, 'EWA DISTRICT, O'AHU

INTRODUCTION

In mid-September 2002, the University of Hawai'i Board of Regents selected the 500-acre Kapolei Makai site as the permanent site for the University of Hawai'i West O'ahu campus. The 500-acre project site is bounded by Farrington Highway to the north; the proposed North-South Road to the east; overgrown, former sugar cane lands to the south; and the Kapolei residential area and Kapolei Golf Course to the west. A large portion of the 500-acre project site has recently been cleared for vegetatable crops or is already under cultivation by Aloun Farms. The Kalo'i and Hunehune Gulches cross the property. Scrub vegetation is found on the former cane fields on the lower southern portion of the site. A few plants of the endangered ko'oloa'ula (Abutilon menziesii) are associated with the scrub vegetation.

Field studies to assess the botanical resources on the proposed University of Hawai'i West O'ahu campus site were conducted from 17 to 20 June 2003. The primary objectives of the field studies were to:

1) prepare a general description of the vegetation on the site;
2) inventory the flora;
3) search for threatened and endangered species as well as species of concern; and
4) identify areas of potential environmental problems or concerns and propose appropriate mitigation measures.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. Topographic maps and a recent, colored aerial

photograph (1" = 200') were examined to determine vegetation cover patterns, terrain characteristics, access, boundaries, and reference points.

The areas with scrub and gulch vegetation were surveyed more intensively as they were more likely to harbor native plants. A few plants of the endangered ko'oloa'ula (Abutilon menziesii) occur on the project site; larger clusters of plants are found on the adjacent lands. All of the ko'oloa'ula plants, both on and off the project site, have been mapped and/or flagged during earlier studies. The plants are monitered periodically by staff from the State Division of Forestry and Wildlife (DOFAW). Actively cultivated farm lands were not surveyed in detail as rare plants were not likely to occur in such areas.

A walk-through survey method was used. Notes were made on plant associations and distribution, substrate types, disturbances, topography, exposure, drainage, etc. Plant identifications were made in the field; plants which could not be positively identified were collected for later determination in the herbarium, and for comparison with the most recent taxonomic literature.

The species recorded are indicative of the season ("dry" vs. "rainy") and the environmental conditions at the time of the survey. A survey taken at a different time of the year and under varying environmental conditions would no doubt yield slight differences in the species list, especially of the weedy, annual plants.

DESCRIPTION OF THE VEGETATION

Nagata (1996) conducted a biological survey (flora and fauna) for the approximately 1,300-acre East Kapolei Master Plan project site. This study covered the proposed 500-acre UH West O'ahu property. It was during the field survey in September and October 1996 that Nagata discovered the endangered ko'oloa'ula plants (see "Endangered Species" section in this report for discussion). In the 1996 study, large portions of the East Kapolei site supported abandoned sugar cane fields with sugar cane (Saccharum officinarum) making up 30 to 50% of the total

vegetation cover. In other places, sugar cane made up less than 5% of the cover with mixed herbs and grasses abundant. A botanical survey for the proposed North-South Road (Char 1997) recorded similar vegetation types.

Today, large areas with sugar cane are no longer present on the study site, having been replaced by a scrub vegetation composed primarily of swollen fingergrass (Chloris barbata), mixed herbaceous species, and small shrubs (subshrubs). The lands on the northern portion of the site, adjacent to Farrington Highway, are under cultivation by Aloun Farms.

Three vegetation types are recognized on the UH West O'ahu site in this report. An inventory of all the plant species observed during the field studies is presented at the end of the report.

Agricultural/Farm

Actively cultivated fields make up the agricultural farm lands vegetation type which covers the majority of the 500-acre project site. Most of the large fields bordering Farrington Highway have recently been bulldozed to clear them of woody growth and were being disked during our field survey in June. Short stumps of koa haole shrubs (Leucaena leucocephala) could be observed here and there in these fields. On the planted fields on the eastern portion of the site, hybrid sweet corn (Zea mays) covers large areas. Other crops observed include bell pepper (Capsicum annuum cv. "Grossum"); eggplant (Solanum melongena); a number of different melon cultivars such as watermelon and Thai watermelon (Citrullus lanatus), and canteloupe and honeydew (Cucumis melo); cultivars of Cucurbita pepo -- zucchini, pumpkin, kabocha; and yard-long bean (Vigna unguiculata).

A few weedy species such as swollen fingergrass, field bindweed (Ipomoea obscura), spiny amaranth (Amaranthus spinosus), and pigweed (Portulaca oleracea) can be found growing among the crop plants. Most of the weedy plants, however, occur along the uncultivated areas which border the fields; these weedy patches receive runoff from the cultivated fields so the weeds tend to

be lush and green, and 2 to 4 ft. tall in some places. Weedy species found here include clumps of Guinea grass (Panicum maximum), field bindweed, lion's ear (Leonotis nepetifolia), young koa haole shrubs, graceful spurge (Chamaesyce hypericifolia), Trianthema portulacastrum), milkweed (Sonchus oleraceus), cheese weed (Malva parviflora), etc. The native 'ilima (Sida fallax) is locally common in some places. One new species not recorded from the island of O'ahu, Russian thistle or tumbleweed (Salsola tragus), was collected and deposited at the Bishop Museum herbarium.

Scrub Vegetation

This vegetation type occupies the southern portion of the project site and is usually 1 to 3 ft. tall. Long dead stalks of sugar cane are scattered throughout this vegetation type. At the time of this survey, the project site was very dry with plant cover 50 to 60%. Bare soil areas with large, knee-deep cracks were prominent and made surveying difficult.

Swollen fingergrass is the most abundant species forming fairly large patches. In some places, buffelgrass (Cenchrus ciliaris) becomes locally abundant and forms a thick mat, 2 to 3 ft. tall. Four herbaceous species are abundant to common; these are false mallow (Malvastrum coromandelianum), coat buttons (Tridax procumbens), fuzzy rattlepod (Crotalaria incana), and golden crown-beard (Verbesina encelioides). Small shrubs of hoary abutilon (Abutilon incanum), 'uhaloa (Waltheria indica), and 'ilima are abundant; these small shrubs have fuzzy, gray to bluish-gray leaves, and give a grayish-blue cast to the vegetation where they form extensive patches, 1 to 3 ft. tall.

Scattered through this scrub cover are taller shrubs of koa haole and sourbush (Pluchea carolinensis), 3 to 10 ft. tall. Other woody components found here in small numbers are young kiawe (Prosopis pallida) and 'opiuma (Pithecellobium dulce) trees, 7 to 12 ft. tall. Interestingly, a few species usually used as landscaping material have established themselves within these former cane fields; these are the small crown flower (Calotropis procera), carrion flower (Stapelia

gigantea), and Sebesten plum (Cordia dichotoma).

On the old, crushed coral-covered cane haul roads and along irrigation ditches, the vegetation is somewhat denser. Koa haole shrubs and Guinea grass are common. Other species forming fairly large patches here include saltbush (Atriplex suberecta), 'uhaloa, slender mimosa (Desmanthus pernambucanus), Macroptilium atropurpureum, Natal redtop grass (Melinis repens), 'ilima, and swollen fingergrass.

Along the lower boundary (makai end), especially along the North-South Road corridor, there are a few plants of the endangered ko'oloa'ula within the project site. A more detailed discussion of the ko'oloa'ula plants on the project site is presented in the "Endangered Species" section of the report.

Gulch Vegetation

Kalo'i Gulch and Hunehune Gulch cross the project site. In most places, the gulches are shallow and narrow, however, Kalo'i Gulch becomes 25 to 45 ft. deep and wider along its eastern segment. A large plunge pool with standing water was found during the field studies. The intermittent streams along the bottom of each of the gulches have eroded down to the hardpan parent material.

The vegetation within the gulches (sides and bottom) is characterized by dense, robust clumps of Guinea grass, 5 to 10 ft. tall. The dense Guinea grass cover tends to exclude other species, but a few patches of California grass (Brachiaria mutica), sourbush, castor bean (Ricinus communis), wild bittermelon (Momordica charantia), comby hyptis (Hyptis pectinata), and cocklebur (Xanthium strumarium) are found where the Guinea grass cover is thin and the soil exposed.

Along the top banks of the gulches, buffelgrass forms a thick mat up to 3 ft. tall, but Guinea grass can also be abundant in places. Koa haole shrubs, 10 to 20 ft. high, occur as scattered stands or can sometimes become very dense and form small thickets, especially along the eastern section of Kalo'i Gulch.

Tangled mats of coccinia vine (Coccinia grandis) are frequently observed climbing up and over the koa haole shrubs. A few kiawe trees, 20 to 25 ft. tall, are also found along the top of the gulches.

ENDANGERED SPECIES

The ko'oloa'ula (Abutilon menziesii) is a member of the hibiscus or mallow family (Malvaceae). It is a much-branched shrub covered by velvety, silvery hairs. The heart-shaped leaves are silvery-green and the small 'ilima-like flowers range in color from pale peach to dark red. Abutilon is found in dry, lowland habitats on the islands of O'ahu, Maui, Lana'i, and Hawai'i (Wagner et al. 1990). In 1986, the species was federally listed as endangered and is protected under the provisions of the Endangered Species Act of 1973, as amended, and Chapter 195D, Hawaii Revised Statutes, as amended. In its natural habitat the plants are threatened by browsing animals, competition from weedy introduced species, fires, predation by insects, loss of native pollinators, and development (U.S. Fish and Wildlife Service 1994).

In September 1996, Nagata found 38 Abutilon menziesii plants on the East Kapolei project site; the reconnaissance survey covered roughly 80% of the property. After the unusually heavy rains in November 1996, Char (1997) conducted an intensive inventory of the plants in December and recorded a total of 88 plants. A year later, in December 1997, Nagata performed a detailed survey flagging and attaching numbered tags to the plants; survey engineers then mapped the plants. The 1997 survey recorded 87 plants, 86 from the East Kapolei site and North-South Road corridor and one plant within the fenceline of the adjacent City and County-owned golf course.

In 1998, a Habitat Conservation Plan (HCP) was prepared for the East Kapolei Master Plan; the HCP is an "umbrella plan" that includes the East Kapolei project as well as the North-South Road project. The HCP provides a description of the development actions which would impact the Abutilon plants and proposes a series of mitigative strategies to address the impacts (PBR 1998).

A few of the endangered Abutilon plants occur on the proposed UH West O'ahu site. These represent the most mauka extension of the Cluster C population. One plant remained at the Cluster D site in Nagata's 1997 study, but it has subsequently died (V. Caraway, DOFAW, pers. comm.); there may still be seeds of Abutilon present in the soil around Cluster D. The Abutilon population is periodically monited by the Division of Forestry and Wildlife (G. Mansker, pers. com.).

DISCUSSION AND RECOMMENDATIONS

The proposed 500-acre UH West O'ahu site was under sugar cane cultivation for nearly a century with the last harvest occurring in 1994, prior to permanent closure of Oahu Sugar Company in 1995 (PBR 1998). Today, only dead stalks of sugar cane and faint traces of planting furrows remain. Weedy scrub vegetation consisting of a mixture of swollen fingergrass and buffelgrass, herbaceous species, and small shrubs covers the former cane fields on the southern half of the property, while the northern portion is actively cultivated for various fruit and vegetable crops by Aloun Farms. The gulches which cross the site support dense Guinea grass and stands of koa haole shrubs.

The vegetation on the project site is dominated by introduced or alien species. A total of 95 plant species were observed during this study. Of these 89 (94%) are introduced; introduced species are all those plants which were brought to the Hawaiian Islands by humans, intentionally or accidentally, after Western contact, that is, Cook's arrival in the islands in 1778. Four species are indigenous or presumably indigenous, that is, they are native to the islands and elsewhere; these are the 'ilima (Sida fallax), hoary abutilon (Abutilon incanum), 'uhaloa (Waltheria indica), and popolo (Solanum americanum). Two species are endemic, that is, they are native only to the Hawaiian Islands; these are the endangered ko'oloa'ula (Abutilon menziesii) and pa'uohi'iaka (Jacquemontia ovalifolia subsp. sandwicensis).

None of the plants found on the project site, with the exception of the

ko'oloa'ula, is a threatened and endangered species or a species of concern (U.S. Fish and Wildlife Service 1999a, 1999b; Wagner et al. 1999). Almost all of the plants can be found in dry, lowland, disturbed habitats throughout the islands. Some of the natives such as the 'ilima, hoary abutilon, and 'uhaloa are common to abundant throughout the scrub vegetation on the project site and elsewhere.

A Habitat Conservation Plan for the endangered ko'oloa'ula plant on the 'Ewa site has already been prepared. Plant material from this population has been propagated and a few outplantings have been made at other locations. The University will need to work closely with the agencies involved in the Habitat Conservation Plan.

LITERATURE CITED

Char, W.P. (Char & Associates). 1997. Summary of findings: Ko'oloa'ula on East Kapolei project site, 'Ewa District, island of O'ahu. Prepared for PBR Hawaii. January 1997.

Char, W.P. (Char & Associates). 1997. Botanical resources study, North-South Road Corridor (H-1 Freeway to Kapolei Parkway), 'Ewa District, island of O'ahu. Prepared for Parsons Brinckerhoff. October 1997.

Evenhuis, N.L. and L.G. Eldredge, editors. 1999-2002. Records of the Hawaii Biological Survey. Bishop Museum Occasional Papers Nos. 58-70.

Nagata, K.M. 1996. East Kapolei Master Plan biological survey. Prepared for PBR Hawaii. September 1996.

Nagata, K.M. 1997. Data survey. Prepared for PBR Hawaii. December 1997.

PBR Hawaii. 1998. East Kapolei Master Plan: Habitat Conservation Plan for Abutilon menziesii. Prepared for State of Hawai'i, Housing Finance Development Corporation. June 1998.

U.S. Fish and Wildlife Service. 1986. Endangered and threatened wildlife and plants: Determination of endangered status for Abutilon menziesii (ko'oloa'ula). Federal Register 51(187): 34412-34415. 26 September 1986.

U.S. Fish and Wildlife Service. 1994. Lana'i plant cluster recovery plan: Abutilon eremitopetalum, Abutilon menziesii, Cyanea macrostegia ssp. gibsonii, Cyrtandra munroi, Gahnia lanaiensis, Phyllostegia glabra var. lanaiensis, Santalum freycinetianum var. lanaiense, Tetramolopium remyi, and Viola lanaiensis. U.S. Fish and Wildlife Service, Portland, OR.

U.S. Fish and Wildlife Service. 1999a. U.S. Fish and Wildlife Service species

list: plants. March 23, 1999. Pacific Islands Office, Honolulu, HI.

U.S. Fish and Wildife Service. 1999b. Endangered and threatened wildlife and plants. 50 CFR 17.11 and 17.12. December 31, 1999.

Wagner, W.L., M.M. Bruegmann, D.R. Herbst, and J. Q.C. Lau. 1999. Hawaiian vascular plants at risk: 1999. Bishop Museum Occasional Papers No. 60.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1990. Manual of the flowering plants of Hawai'i. 2 vols. University of Hawai'i Press and Bishop Museum Press, Honolulu. Bishop Museum Special Publication 83.

Wagner, W.L. and D.R. Herbst. 1999. Supplement to the manual of the flowering plants of Hawai'i, pp. 1855-1918. In: Wagner, W.L., D.R. Herbst, and S.H. Sohmer, Manual of the flowering plants of Hawai'i. Revised edition. 2 vols. University of Hawai'i Press and Bishop Museum Press, Honolulu.

APPENDIX A

PLANT SPECIES LIST -- U.H., West O'ahu

The following checklist is an inventory of all the plants observed on the project site during the field studies. The plants are arranged alphabetically by families into each of two groups: Dicots and Monocots. The taxonomy and nomenclature of the flowering plants, Dicots and Monocots, are in accordance with Wagner et al. (1990) and Wagner and Herbst (1999). The few recent name changes are those reported in the Hawaii Biological Survey series (Evenhuis and Eldredge, editors, 1999-2002).

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name(s), when known.
3. Biogeographic status. The following symbols are used:
   - E = endemic = native only to the Hawaiian Islands;
   - I = indigenous = native to the Hawaiian Islands and elsewhere;
   - I? = questionably indigenous = data not clear if dispersal to the islands by natural or human-related mechanisms, but weight of evidence suggests probably natural;
   - X = introduced or alien = all those plants brought to the Hawaiian Islands by humans, intentionally or accidentally, after Western contact, that is Cook's arrival in the islands in 1778;
   - X? = questionably introduced = dates of introduction are very early/unclear; may be indigenous or of Polynesian introduction.
4. Presence (+) or absence (-) of a particular species within each of three vegetation types recognized on the project site (see text for discussion):
   - a = Agricultural/Farm Lands
   - s = Scrub Vegetation
   - g = Gulch Vegetation

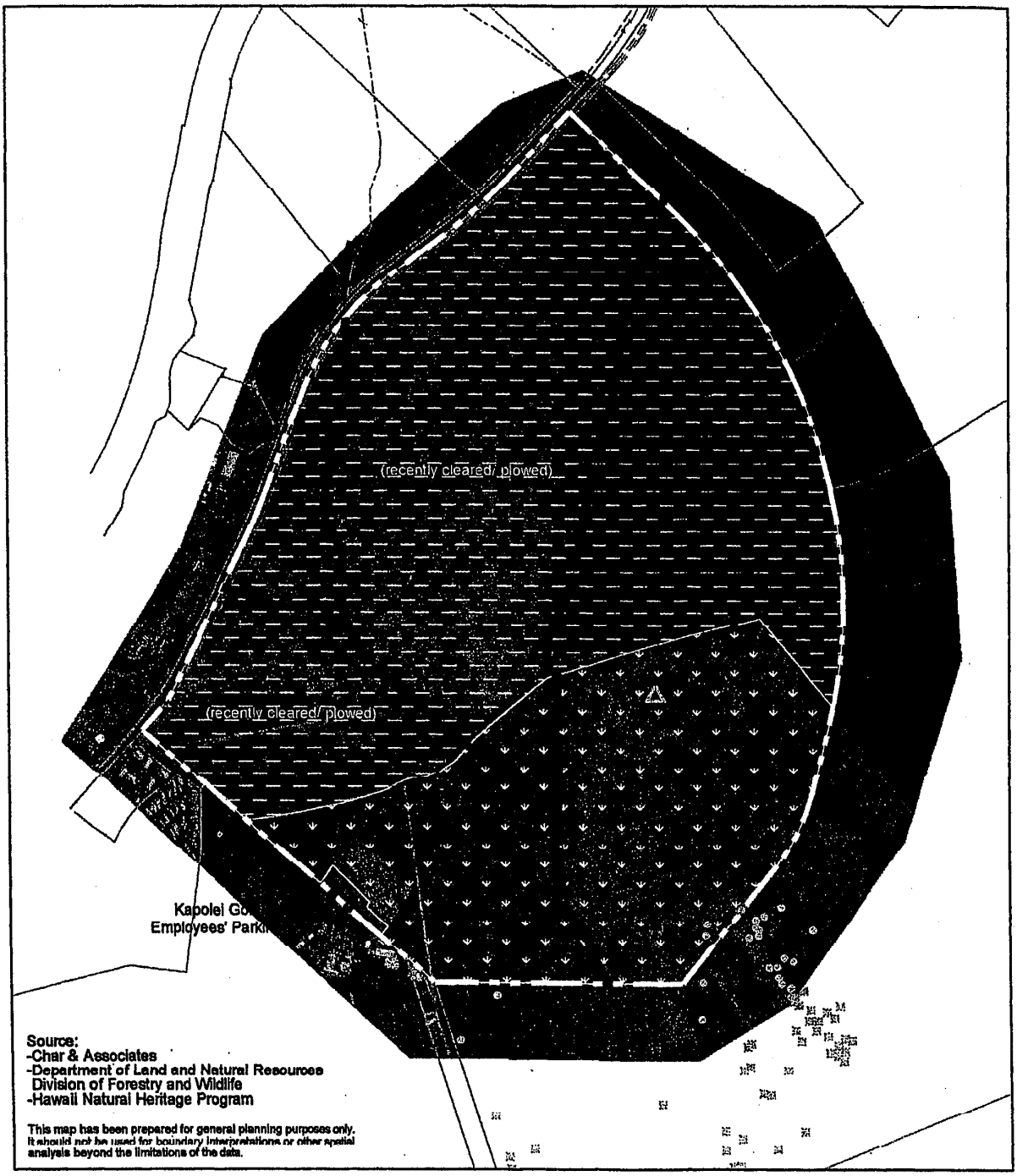
Scientific name	Common name	Status	Vegetation type a	s	g
FLOWERING PLANTS					
DICOTS					
AIZOACEAE (Fir-marigold family)					
Trianthema portulacastrum L.		X	+	+	+
AMARANTHACEAE (Amaranth family)					
Amaranthus spinosus L.	spiny amaranth, pakai kuku	X	+	+	-
Amaranthus viridis L.	slender amaranth, pakai	X	+	+	-
ANACARDIACEAE (Mango family)					
Schinus terebintifolius Raddi	Christmas berry	X	-	+	-
ASCLEPIADACEAE (Milkweed family)					
Calotropis procera (Aiton) W.T. Aiton	small crown flower	X	-	+	-
Stapelia gigantea N.E. Brown	carrion flower, Zulu-giant	X	-	-	+
ASTERACEAE (Daisy family)					
Bidens alba var. radiata (Schultz-Bip.) Ballard ex Melchert		X	+	-	-
Bidens pilosa L.	Spanish needle, ki, ki nehe	X	+	-	+
Emilia fosbergii Nicolson	flora's paintbrush, pualele	X	+	+	-
Pluchea carolinensis (Jacq.) G. Don	sourbush, pluchea	X	+	+	+
Pluchea indica (L.) Less.	Indian fleabane	X	+	+	-
Sonchus oleraceus L.	sowthistle	X	+	+	-
Tridax procumbens L.	coat buttons	X	-	+	+
Verbesina encelioides (Cav.) Benth. & Hook.	golden crown-beard	X	+	+	-
Xanthium strumarium var. canadense (Mill.) Torr. & A. Gray	cocklebur, kikania	X	-	-	+
BIGNONIACEAE (Bignonia family)					
Spathodea campanulata P. Beauv.	African tulip tree	X	-	+	-

Scientific name	Common name	Status	Vegetation type a	s	g
BORAGINACEAE (Borage family)					
Cordia dichotoma Forst. f.	Sebesten plum	X	-	+	-
CAPPARACEAE (Caper family)					
Cleome gynandra L.	wild spider flower, hohohina	X	+	-	-
CHENOPODIACEAE (Goosefoot family)					
Atriplex suberecta Verd.	saltbush	X	+	+	+
Chenopodium murale L.	'aheahea	X	+	+	-
Salsola tragus L.	Russian thistle, thumbleweed	X	+	+	-
CONVOLVULACEAE (Morning glory family)					
Ipomoea cairica (L.) Sweet	koali 'ai, koali	X?	-	-	+
Ipomoea obscura (L.) Ker-Gawl.	field bindweed	X	-	+	+
Ipomoea triloba L.	little bell, pink bindweed	X	+	+	-
Jacquemontia ovalifolia ssp. sandwicensis (A. Gray) K. Robertson	pa'uohi'iaka	E	-	+	-
Merremia aegyptia (L.) Urb.	hairy merremia, koali kua hulu	X?	+	+	-
CUCURBITACEAE (Gourd family)					
Citrullus lanatus (Thunb.) Matsum. & Nakai	watermelon	X	+	-	-
Coccinia grandis (L.) Voigt	coccinia, ivy gourd	X	+	-	+
Cucumis melo L. various cultivars	cantaloupe, honeydew	X	+	-	-
Cucurbita pepo L. various cultivars	zucchini, pumpkin, kabocha	X	+	-	-
Momordica charantia L.	wild bittermelon	X	+	-	+
EUPHORBIACEAE (Spurge family)					
Chamaesyce hirta (L.) Millsp.	hairy spurge, garden spurge	X	-	+	+
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	X	+	+	+
Chamaesyce hyssopifolia (L.) Sm.		X	+	-	+
Euphorbia heterophylla L.	Mexican fireweed	X	+	-	-
Ricinus communis L.	castor bean, koli	X	+	+	+

Scientific name	Common name	Status	Vegetation type a	s	g
FABACEAE (Pea family)					
Acacia farnesiana (L.) Willd.	klu	X	+	+	-
Cassia sp.		X	-	+	-
Chamaecrista nictitans (L.) Moench	partridge pea, lauki	X	-	+	-
Crotalaria incana L.	fuzzy rattlepod, kukaehoki	X	+	+	-
Crotalaria pallida Aiton	smooth rattlepod, pikakani	X	+	-	-
Desmanthus pernambucanus (L.) Thellung	slender mimosa	X	+	+	+
Indigofera hendecaphylla Jacq.	creeping indigo	X	-	+	-
Indigofera suffruticosa Mill.	indigo, 'iniko	X	+	+	-
Leucaena leucocephala (Lam.) de Wit	koa haole, ekoa	X	+	+	+
Macroptilium atropurpureum (DC) Urb.		X	-	+	-
Macroptilium lathyroides (L.) Urb.	wild bean, cow pea	X	+	-	-
Pithecellobium dulce (Roxb.) Benth.	'opiuma	X	-	+	+
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	kiawe	X	+	+	+
Senna occidentalis (L.) Link	coffee senna, 'auko'i	X	+	-	-
Vigna unguiculata ssp. sesquipedalis (L.) Verdc.	yard-long bean	X	+	-	-
LAMIACEAE (Mint family)					
Hyptis pectinata (L.) Poit.	comb hyptis	X	+	-	+
Leonotis nepetifolia (L.) R. Br.	lion's ear	X	+	+	+
MALVACEAE (Mallow family)					
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	X	+	-	-
Abutilon incanum (Link) Sweet	hoary abutilon, ma'o	I?	+	+	+
Abutilon menziesii Seem.	ko'oloa'ula	E	-	+	-
Malva parviflora L.	cheese weed	X	+	-	-
Malvastrum coromandelianum (L.) Garcke	false mallow, hauuoi	X	+	+	-
Sida ciliaris L.		X	+	+	-
Sida fallax Walp.	'ilima	I	+	+	+
Sida spinosa L.	prickly sida	X	+	+	-
MELIACEAE (Mahogany family)					
Melia azedarach L.	Chinaberry, pride of India	X	-	+	-

Scientific name	Common name	Status	Vegetation type a	s	g
NYCTAGINACEAE (Four-o'clock family)					
Boerhavia coccinea Mill.		X	-	+	-
PASSIFLORACEAE (Passion flower family)					
Passiflora foetida L.	running pop, poha poha	X	-	+	-
PORTULACACEAE (Purslane family)					
Portulaca oleracea L.	common purslane, pigweed	X	+	-	-
SOLANACEAE (Nightshade family)					
Capsicum annuum L. cultivar "Grossum"	bell pepper	X	+	-	-
Datura stramonium L.	Jimson weed, la'au hano	X	-	+	-
Nicandra physalodes (L.) Gaertn.	apple of Peru	X	+	-	+
Nicotiana glauca R.C. Graham	tree tobacco	X	-	+	-
Solanum americanum Mill.	popolo, glossy nightshade	I?	+	+	-
Solanum lycopersicon var. cerasiforme (Dunal) Spooner, Anderson & Jansen	currant tomato, wild tomato	X	+	+	-
Solanum melongena L. various cultivars	eggplant, long eggplant	X	+	-	-
STERCULIACEAE (Cacao family)					
Waltheria indica L.	'uhaloa, hi'aloa, kanakaloa	I?	-	+	-
VERBENACEAE (Verbena family)					
Lantana camara L.	lantana, lakana	X	-	+	-
Stachytarpheta cayennensis (Rich.) Vahl	nettle-leaved vervain, owi, oi	X	-	+	-
MONOCOTS					
MUSACEAE (Banana family)					
Musa X paradisiaca L.	banana, mai'a	X	-	-	+
CYPERACEAE (Sedge family)					
Cyperus rotundus L.	nutgrass, nut sedge	X	+	-	-

Scientific name	Common name	Status	Vegetation type a	s	g
POACEAE (Grass family)					
Bothriochloa pertusa (L.) A. Camus	pitted beardgrass	X	-	+	-
Brachiaria mutica (Forssk.) Stapf	California grass	X	-	-	+
Cenchrus ciliaris L.	buffelgrass	X	+	+	+
Cenchrus echinatus L.	common sandbur, 'ume'alu	X	+	-	-
Chloris barbata (L.) Sw.	swollen fingergrass, mau'ulei	X	+	+	+
Cynodon dactylon (L.) Pers.	Bermuda grass, manienie	X	-	+	-
Digitaria insularis (L.) Mez ex Ekman	sourgrass	X	+	-	+
Digitaria sp.	crabgrass	X	-	+	-
Eleusine indica (L.) Gaertn.	wiregrass, goosegrass	X	+	-	-
Eragrostis amabilis Wight & Arnott	lovegrass	X	-	+	-
Eragrostis cilianensis (All.) Link	stinkgrass	X	-	+	-
Melinis repens (Willd.) Zizka	Natal redtop, Natal grass	X	-	+	+
Panicum maximum Jacq.	Guinea grass	X	+	+	+
Panicum maximum var. trichoglume Eyles ex Robyns	green panicgrass	X	-	-	+
Saccharum officinarum L.	sugar cane, ko	X	-	+	-
Setaria verticillata (L.) P. Beauv.	bristly foxtail, mau'u pilipili	X	+	-	+
Sorghum bicolor (L.) Moench	sorghum	X	+	+	-
Zea mays L.	hybrid corn	X	+	-	-



LEGEND

- Project Site Boundary
- Abutilon Menziesii Plant
- Area where Abutilon Menziesii Plants Died-Off but where Seeds Remain
- AG./ Farm
- Scrub
- Gulch

Flora Study

UH WEST O'AHU

EAST KAPOLEI, O'AHU

NORTH

LINEAR SCALE (FEET)

0 500 1,000 1,500

PBR HAWAII

Appendix E
Botanical Survey
W. Char
(March 2004)

BOTANICAL RESOURCES ASSESSMENT STUDY

KAPOLEI PARKWAY EXTENSION FROM NORTH-SOUTH ROAD TO OR&L RIGHT-OF-WAY

KAPOLEI, O'AHU

by

Winona P. Char

CHAR & ASSOCIATES
Botanical Consultants
Honolulu, Hawai'i

Prepared for: PARSONS BRINCKERHOFF

Revised March 2004

BOTANICAL RESOURCES ASSESSMENT STUDY
KAPOLEI PARKWAY EXTENSION FROM NORTH-SOUTH ROAD TO OR&L RIGHT-OF-WAY
KAPOLEI, O'AHU

INTRODUCTION

The proposed Kapolei Parkway Extension will connect the proposed North-South Road with the OR&L right-of-way (ROW) where the existing Kapolei Parkway currently ends. A botanical survey for this extension of the Kapolei Parkway was conducted in two sections (Figure 1).

The first section of Kapolei Parkway is from the proposed intersection with North-South Road to the proposed intersection with Renton Road. The botanical survey area for this section consists of approximately 80 acres of City and County-owned lands located between Varona Village and Kalo'i Gulch/'Ewa Villages Golf Course (Figure 2). For the most part, the proposed parkway follows along or close to an existing paved road which accesses the golf course maintenance facility. In other places, it crosses koa haole/buffel grass scrub vegetation. The endangered Abutilon menziesii, common names ko'oloa'ula and red 'ilima, is known to occur on the adjacent State-owned lands; some Abutilon have also been recorded on the City and County-owned lands (Ohashi and PBR Hawaii 2003).

The second section of Kapolei Parkway is from the proposed intersection with Renton Road to the OR&L right-of-way (ROW). The botanical survey area for this section is an approximately 20-acre area bound by Renton Road to the west, the existing 'Ewa Mahiko Park to the north, the 'Ewa Gentry subdivision and a portion of the OR&L ROW to the east, and Kalo'i Gulch and the OR& L ROW to the south (Figure 3). This property is also owned by the City and County of Honolulu. The proposed parkway follows along an existing paved cane haul road. Except for Kalo'i Gulch, most of the site appears to have been graded in the past.

Field studies to assess the botanical resources on the ±80-acre study site including the proposed Kapolei Parkway corridor from North-South Road to Renton Road were conducted on 09 January 2004 by a team of two botanists. The Renton Road to OR&L ROW section was surveyed on 02 February 2004. The primary objectives of the field survey were to:

1) prepare a general description of the vegetation on the study sites; and
2) search for Abutilon menziesii as well as other threatened and endangered species and species of concern.

SURVEY METHODS

For the North-South Road to Renton Road section of Kapolei Parkway, a colored aerial photograph (roughly 1" = 250') was used, while the design and construction plans were

used for the Renton Road to OR&L ROW section. These were examined prior to the field studies to familiarize the botanists with vegetation cover patterns, terrain characteristics, access, boundaries, and reference points.

The proposed parkway corridor on the ±80-acre site was flagged and staked by the survey engineers before our field survey. Thirty (30)-foot wide transects were made through the koa haole/buffel grass scrub found between the existing paved road and the edge of the golf course. This is identified as "Area E" on Figure 1; plants of Abutilon are known from this portion of the study site. Less intensive transects were conducted for the more recently disturbed area makai of the existing paved road; this is identified as "Varona Village Extension" on Figure 1.

The survey for the proposed parkway corridor on the ±20-acre site between Renton Road to OR&L ROW focused on the less disturbed Kalo'i Gulch area. Notes were made on plant associations and distribution, disturbances, substrate types, topography, exposure, drainage, etc.

DESCRIPTION OF THE VEGETATION

The plant names used in this report follow Wagner et al. (1990) and Wagner and Herbst (1999). The few recent name changes are those reported in the Hawaii Biological Survey series (Evenhuis and Eldredge, eds., 1999-2002). The vegetation is described on each of the two areas within the ±80-acre site (Area E and Varona Village Extension), and on the ±20-acre Renton Road to OR&L ROW section.

Area E

Koa haole (Leucaena leucocephala)/buffel grass (Cenchrus ciliaris) scrub covers the portion of the study site located between the existing paved road and the golf course. Short-statured thickets of koa haole, 3 to 5 ft. tall, are scattered throughout this vegetation type. Buffel grass, 1 to 2 ft. tall, forms dense mats to loose tussocks between the thickets. Locally common are scattered patches of swollen fingergrass (Chloris barbata), stinkgrass (Eragrostis cilianensis), 'ilima (Sida fallax), Guinea grass (Panicum maximum), 'aheahea (Chenopodium murale), and hoary abutilon (Abutilon incanum). A few young trees of kiawe (Prosopis pallida), Chinaberry (Melia azedarch), and monkeypod (Samanea saman) can be observed here and there. Old bulldozer tracks and areas with coralline substrate are occasionally. encountered. Scattered patches of false mallow (Malvastrum coromandelianum), Trianthema portulacastrum, swollen fingergrass, little bell (Ipomoea triloba), spiny amaranth (Amaranthus spinosus), 'aheahea, Macroptilium atropurpureum, and castor bean (Ricinus communis) are common on these more recently disturbed areas.

Along the edge of the golf course (slopes of Kalo'i Gulch), the woody components become very dense. Koa haole thickets are 7 to 12 ft. tall and there are small, scattered stands of emergent kiawe, monkeypod, Eucalyptus, and 'opiuma (Pithecellobium dulce) trees. Shrubs of hairy abutilon (Abutilon grandifolium), klu

(Acacia farnesiana), and sourbush (Pluchea carolinensis) are common. Robust clumps of Guinea grass, 5 to 6 ft. tall, and buffel grass, up to 3 ft. tall, form a dense cover between the woody components.

Four of the Abutilon menziesii locations occur on Area E in open koa haole/ buffel grass scrub (see Rare Plants section of this report).

Varona Village Extension

This portion of the study area located makai of the existing paved road has been bulldozed somewhat recently. Remnants of old house sites, old mango (Mangifera indica) and kalamungai (Moringa oleifera) trees, overgrown garden plots, and rusted parts of refrigerators, stoves, sheet metal, and a Suzuki Samurai vehicle can be found here. The vegetation is composed primarily of weedy, annual plants. Swollen fingergrass is the dominant component. Lion's ear (Leonotis nepetifolia), little bell, field bindweed (Ipomoea obscura), feather fingergrass (Chloris virgata), and saltbush (Atriplex suberecta) are locally abundant. Other weeds observed here include golden crown-beard (Verbesina encelioides), Spanish needle (Bidens pilosa), smooth rattlepod (Crotalaria pallida), 'uhaloa (Waltheria indica), castor bean, and wild tomato (Solanum lycopersicon).

Where the property borders the HECO easement, open, grassy fields of buffel grass are found. The woody components make up less than 5% of the cover; these include short-statured koa haole shrubs and young trees of kiawe and 'opiuma. Three medium-sized kiawe trees line the makai side of the existing paved road near the HECO easement. One plant of Abutilon is found associated with these trees. Also in this area are numerous clumps of Russian thistle or tumbleweed (Salsola tragus).

On the southwest corner of the property, there are large piles of coral rubble and boulders. This was the staging area for a sewer line at one time. The piles of excavated material are covered here and there with patches of tree tobacco shrubs (Nicotiana glauca), mats of Sida ciliaris and saltbush, and shrubs of 'ilima, 'uhaloa, and sourbush.

Renton Road to OR&L ROW Section

The proposed parkway alignment in this section follows along a former cane haul road. It consists of a thin layer of asphalt over crushed coral with patches of asphalt missing in many places. Along the open, grassy field of the park boundary is a narrow band of weedy vegetation with patches of reddish-colored soil. The weedy vegetation consists of a mixture of swollen fingergrass, buffel grass, green panicgrass (Panicum maximum var. trichoglume), and saltbush. A few scattered koa haole shrubs, 3 to 4 ft. tall, occur here. This area appears to have been graded when the parks playing field was installed.

On the makai side of the cane haul road, koa haole scrub borders the roadside and extends down the slopes into Kalo'i Gulch. Along the roadside, the shrubs are 6 to 10 ft. tall, but become somewhat taller, 10 to 15 ft. tall, within the gulch. Scattered through the koa haole scrub are emergent trees of kiawe and 'opiuma, 20 to 25 ft. tall. Other woody

components include sourbush and castor bean. Buffel grass and Guinea grass form-dense clumps up to 3 ft. tall in most places.

On parts of the gulch slope, there are areas with exposed reddish-colored soil; a number of dirt bike trails also are found within the gulch. These open areas support a weedy mixture of plants which include castor bean, cocklebur (Xanthium strumarium), golden crown-beard, hairy merremia (Merremia aegyptia), spiny amaranth, false mallow, and Jimson weed (Datura strumonium). 'Uhaloa is locally abundant on these exposed areas. Other native species observed in the gulch area are 'ilima and hoary abutilon.

Along the gulch bottom, the vegetation is primarily Guinea grass and buffel grass with scattered koa haole shrubs and young kiawe and 'opiuma. In some places, there are small pools of standing muddy water; California grass (Brachiaria mutica) and primrose willow (Ludwigia octovalvis) are associated with these areas. Parts of the gulch adjacent to the bridge are concrete lined.

RARE PLANTS

The approximate locations of Abutilon menziesii are plotted on Figure 2. Only single plants are found at locations 2 to 5. At location 1, there is a large, multi-stemmed plant about 5 ft. tall; a young, single-stemmed plant about 2.5 ft. tall; and a seedling, 4 inches tall. No Abutilon menziesii was found in the Renton Road to OR&L ROW section.

The plants as well as the area around the plants have been flagged with blue and white stripped flagging. G. Mansker, Division of Forestry and Wildlife, will more accurately map the plants using a GPS unit later on.

No other threatened and endangered species or species of concern (U.S. Fish and Wildlife Service 1999; Wagner et al. 1999) were found during the field studies. The other native species which were observed on the study site are common species which can be found throughout the islands. These are the 'ilima (Sida fallax), 'uhaloa (Waltheria indica), hoary abutilon (Abutilon incanum), popolo (Solanum americanum), and pa'uohi'iaka (Jacquemontia ovalifolia ssp. sandwicensis).

DISCUSSION

The vegetation on the City and County-owned lands are dominated by introduced or alien species such as koa haole, buffel grass, kiawe, swollen fingergrass, etc. For the most part, the proposed Kapolei Parkway alignment follows along an existing paved road. None of the plants found on the property, with the exception of the Abutilon menziesii, is a threatened and endangered species or a species of concern.

The City and County will need to work closely with the other agencies involved in the Habitat Conservation Plan which has been prepared for the endangered Abutilon on the Kapolei site. Plant material from the five locations within the study site will need to be collected for propagation and included in future outplantings.

References

Evenhuis, N.L. and L.G. Eldredge, editors. 1999-2002. Records of the Hawaii Biological Survey. Bishop Museum Occasional Papers Nos. 58-70.

Ohashi, Y. and PBR Hawaii. 2003. Habitat Conservation Plan for Abutilon menziesii at Kapolei. Prepared for Parsons Brinckerhoff and State of Hawaii, Department of Transportation. November 2003.

U.S. Fish and Wildlife Service. 1999. Endangered and threatened wildlife and plants. 50 CFR 17.11 and 17.12. December 31, 1999.

Wagner, W.L., M.M. Bruegmann, D.R. Herbst, and J. Q.C. Lau. 1999. Hawaiian vascular plants at risk: 1999. Bishop Museum Occasional Papers No. 60.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1990. Manual of the flowering plants of Hawai'i. 2 vols. University of Hawai'i Press and Bishop Museum Press, Honolulu. Bishop Museum Special Publication 83.

Wagner, W.L. and D.R. Herbst. 1999. Supplement to the Manual of the flowering plants of Hawai'i, pp. 1855-1918. In: Wagner, W.L., D.R. Herbst, and S.H. Sohmer, Manual of the flowering plants of Hawai'i. Revised edition. 2 vols. University of Hawai'i Press and Bishop Museum Press, Honolulu.

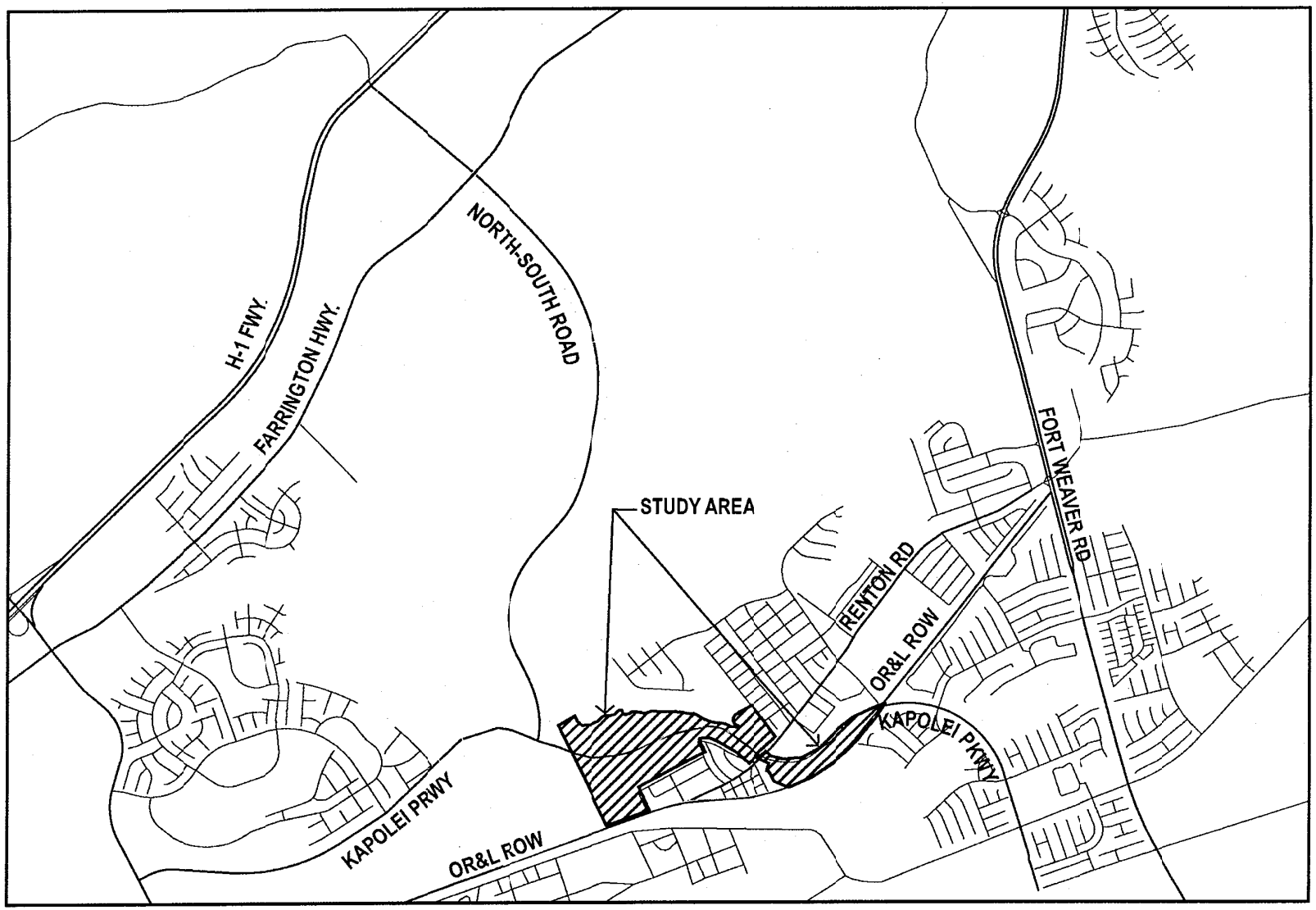


Figure 1
Regional View of Kapolei Parkway Extension Study Area

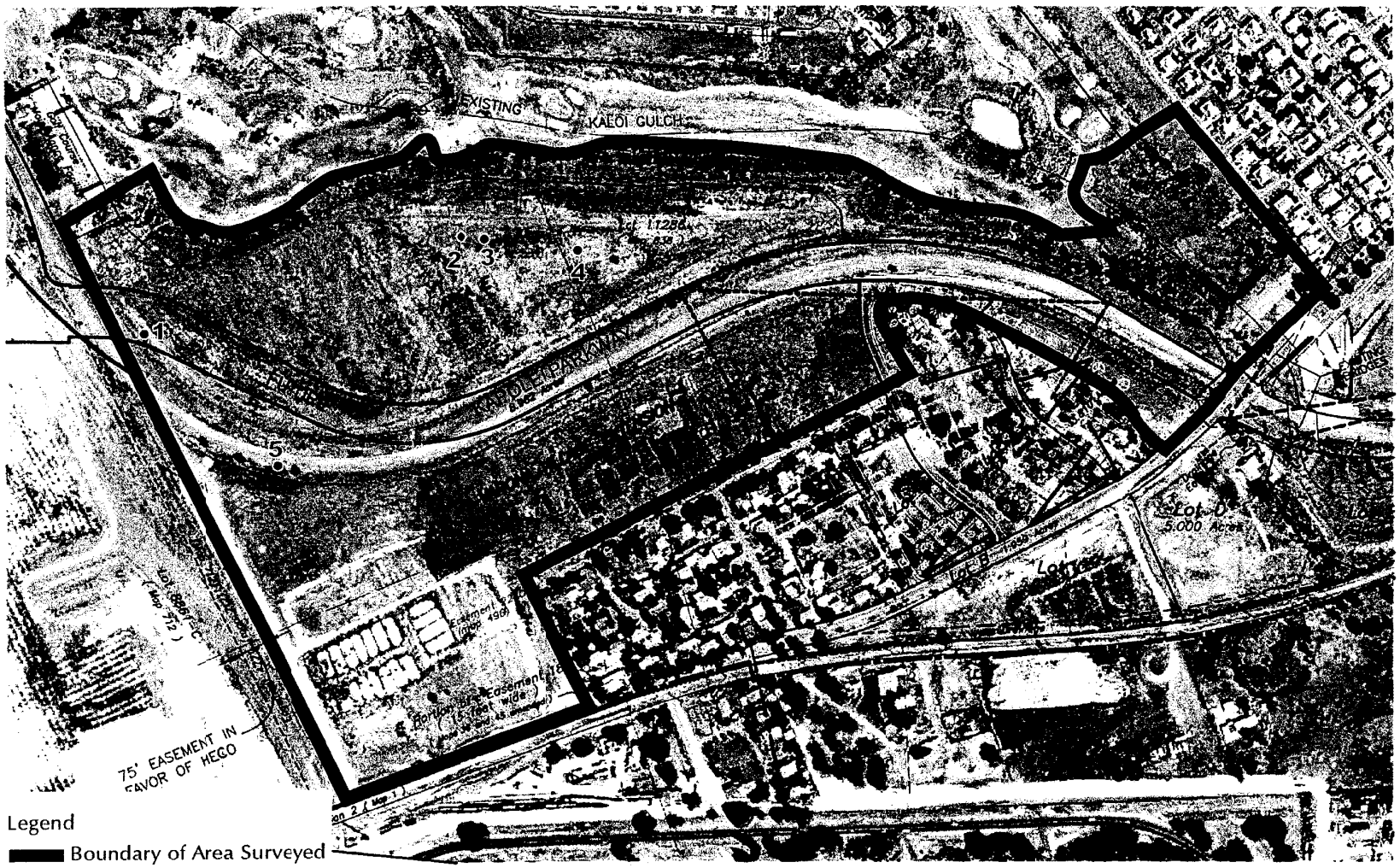


Figure 2
Kapolei Parkway Extension Study Area - North-South Road to Renton Road Section

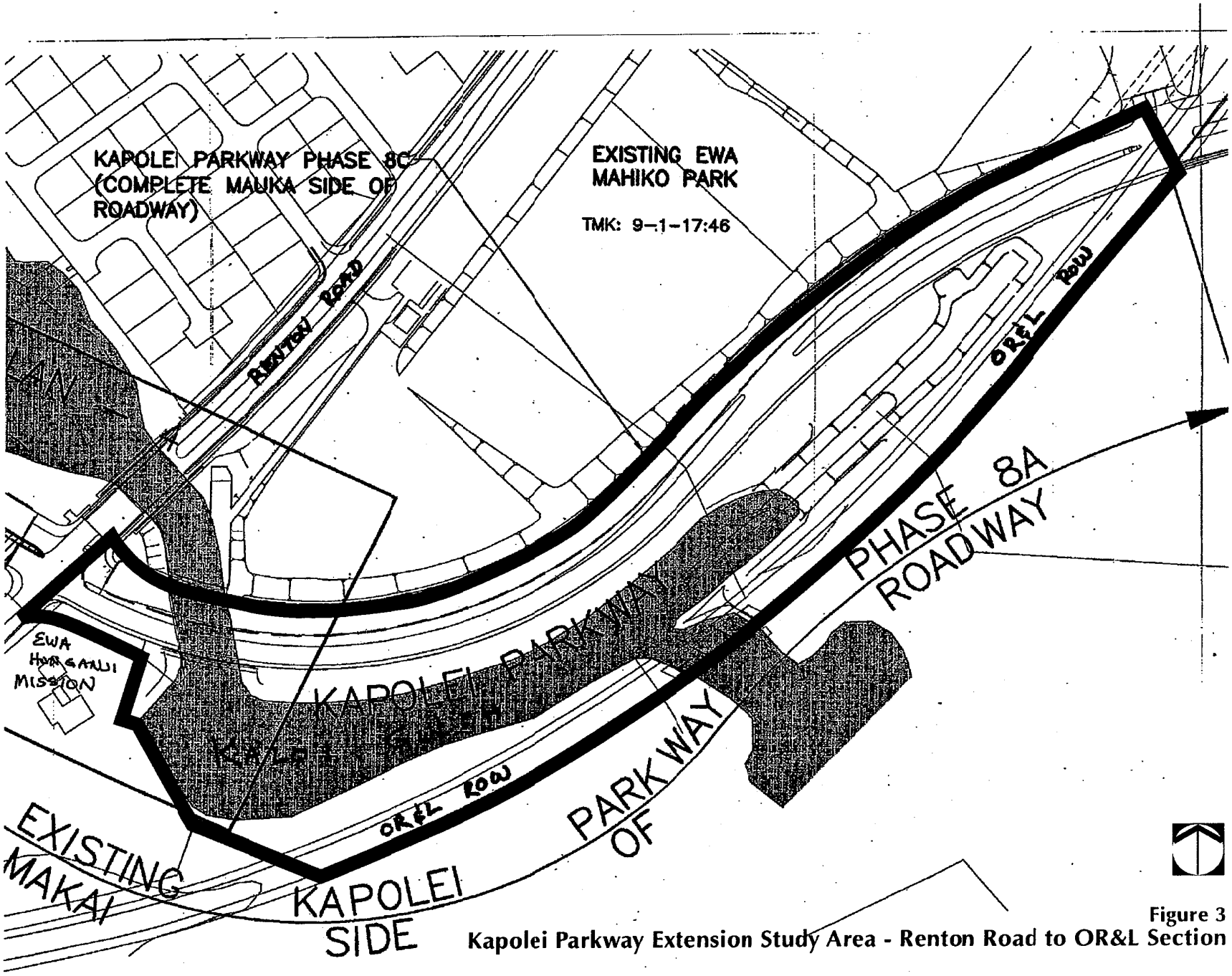


Figure 3
Kapolei Parkway Extension Study Area - Renton Road to OR&L Section

Appendix F

Interim Management Report for Abutilon menziesii (April 24, 2001)

Department of Land and Natural Resources
Division of Forestry and Wildlife
Natural Area Reserve System

Interim Management Report
for
Abutilon menziesii
April 24, 2001

The following is a summary of activities implemented by the Department of Land and Natural Resources (DLNR) under the agreement, East Kapolei –Interim Mitigation Plan for the Endangered species, *Abutilon menziesii,* during the 31-month October 1, 1998 to April 24,2001. This report will summarize the activities completed during each of the 10 quarters during that period. We have not completed all activities set forth in the agreement. The only task that remains is the construction of a greenhouse (Task # 5). This is not a final report. A final report will be submitted when all tasks have been completed.

Task 1: Maintain existing population of Abutilon menziesii on State land at East Kapolei, Oahu, Hawaii. This work will include the following:

1. Monitoring

A total of 76 visits were made to the *Abutilon menziesii* plants at Kapolei between October 1998 and March 2000. Two DLNR staff conducted most of the site visits. The breakdown of the visits per quarter can be found in Table 1 below. Each plant was given a number and a permanent tag. The numbers given to plants followed those assigned during the survey done by Kenneth Nagata in December 1997, where appropriate. New numbers were assigned to plants not located during the Nagata surveys. As part of the monitoring process, four mature plants not found in the original survey were discovered; three are outside the project area near the Ewa golf course maintenance building and one adjacent to population C-1. Therefore the number of original plants in the East Kapolei population was the 86 found during the December 1997 survey by Kenneth Nagata, plus the 4 new plants discovered during the site visits made by DLNR staff during this project, for a grand total of 90 plants. We were successful in propagating clones from 62 of the 90 plants. In the Interim Report of 20 June 2000 we stated that there were 62 remaining plants. Several of these plants have since died due to natural senescence. The number of plants still alive is between 30 and 50. Determining whether an *Abutilon menziesii* is still alive is difficult. The plant may appear to be only dead sticks but a heavy rain will cause the plant to suddenly sprout green leaves. Therefore it is difficult to give a definitive total on the plants still alive in East Kapolei. We have contracted with Hawaii Natural Heritage Program to produce a detailed GIS map of all known *Abutilon menziesii* plants and plant locations. This map will be provided in the final report for this project.

Table 1. Site visits to East Kapolei *Abutilon menziesii* plants

Quarter	Number of Site Visits	Total Person Days
October 1998 - December 1998	13	26
January 1999 - March 1999	6	12
April 1999 - June 1999	7	16
July 1999 - September 1999	8	16
October 1999 – December 1999	7	14
January 2000 March 2000	8	16
April 2000 – June 2000	8	8
July 2000 – September 2000	5	5
October 2000 – December 2000	6	6
January 2001 – March 2001	8	8

2. Maintenance

Plants were watered during each visit and treated six separate times with systemic insecticide to control hibiscus snow scale, ants, and mealy bugs. Vegetation immediately adjacent to each plant was removed during each visit to keep potential fire fuels away from the plant. Plants were not fertilized because of a concern of encouraging soft growth in the wild plants that could not be sustained without the installation of a permanent irrigation system.

3. Security

A fire plan has been implemented for the area that: creates a fire break around the *Abutilon menziesii* populations and individual plants; identifies the fire fighting resources available near the East Kapolei *Abutilon menziesii* population; and provides information to these resources to assist them with protecting these plants from fire. We have contracted the Hawaii Natural Heritage Program to produce a detailed GIS map of all the known *Abutilon menziesii* plants and the key fire resources in the area. This map will be provided to all the Fire Department Stations listed in this fire plan for their reference in case of a fire. This map will be a part of the final report. The TMK for the East Kapolei area where the plants are found is Oahu 9:1:6, parcel 109. The nearest Fire Station to the area is Kapolei Fire Station (Station 40). Station 40 is approximately 2.5 miles from the *Abutilon menziesii* populations.

The potential ignition sources for fires in the East Kapolei area are accidental ignitions from children playing with fire, careless smoking, vehicles in dry flashy fuels, misuse of fireworks, and intentionally set arson fires. Fireworks are prevalent during the New Years and Fourth of July holidays and illegal aerial fireworks are becoming more prevalent during these times. The potential of fireworks as an ignition source in Kapolei is quite high. Illegal motorcycle use of the parcel occurs and is another likely source for fires in the area. To mitigate for the potential for fire we have removed all fuel immediately adjacent to each plant. In late June 2000, we contracted an agricultural disc to create a 30-foot barrier of bare soil around each plant or each cluster of plants. This firebreak is still in place because we have not received any significant rainfall in the area since the establishment of this firebreak.

The fire fighting resources available at Station 40 in Kapolei are an Engine, a Ladder truck, and a Brush Fire truck. A Honolulu Fire Department Battalion Chief is stationed at Station 40. The next closest fire units are at Station 12 in Waipahu. Station 12 has an Engine, a Ladder truck, and a Water Tender. Station 35 in Makakilo is the third closest unit to the area and it has an Engine on site. Station 28 in Makakilo is the fourth closest unit with an Engine and a Water Tender on station. The GIS map we developed shows all the access routes to the main population clusters. This map will be provided the above Fire Stations.

Task 2: Propagate a total representation of plants through seeds and cuttings from the East Kapolei Abutilon menziesii population.

Task 2 of the agreement has been completed. All the known East Kapolei Abutilon menziesii plants have been propagated through cuttings. Figure 1 shows some of the 630 plants we have propagated from cuttings so far. The bullets below detail the propagation work we have done. Table 2 below details the cuttings taken from the East Kapolei *Abutilon menziesii* plants per quarter. Each cutting taken from an East Kapolei plant can be divided into up to six cuttings. We attempt to produce a plant from each cutting but not all are successful. Figure 2 is a photo of many *Abutilon menziesii* plants ready for outplanting.

- A total of 630 plants have been propagated from cuttings of 62 East Kapolei individuals.
- 220 seedlings have been produced from seed. This seed was collected from nursery plants grown from cuttings of the East Kapolei population.
- Research on optimum germination method is ongoing. We are using a heating mat under the seeding tray to speed germination rate. This method has been successful in speeding germination time from 3 to 4 months with regular germination technique to 2 to 3 weeks using this technique.
- We have sent over 800 seeds to Dr. Alvin Yoshinaga at Lyon Arboretum. A percentage of these are sent to the National Seed Storage Lab in Fort Collins, Colorado. These seeds are from nursery plants.
- We have seeds from 39 of the East Kapolei plants in storage at the Pahole Rare plant facility.

Table 2: Cuttings taken of East Kapolei Abutilon menziesii

Quarter	Number of Cuttings Taken
October 1998 - December 1998	120
January 1999 - March 1999	200
April 1999 - June 1999	70
July 1999 - September 1999	30
October 1999 – December 1999	36
January 2000 – March 2000	28
April 2000 – June 2000	40
July 2000 – September 2000	0
October 2000 – December 2000	0
January 2001 – March 2001	70

Figure 1: *Abutilon menziesii* cuttings

Figure 2: Plants grown from cuttings ready for outplanting

Task 3: Establish two wild populations of Abutilon menziesii in appropriate habitat

Two outplanting sites have been identified as the initial sites for the establishment of new wild populations of *Abutilon menziesii*. The first site is on unencumbered State land on the Mokuleia side of Kaena Point and the second is on City and County of Honolulu land in Koko Crater.

The first ouplanting site is located at the Koko Crater Botanical Garden. The Honolulu Botanical Gardens provided a 100 x 100 foot site set aside for the plant for the initial planting. On 16 November 2001, 140 *Abutilon menziesii* were planted at the site provided. These plants represent 2 complete sets of each of the original East Kapolei plants. The planting was accomplished with Honolulu Botanical gardens staff, DLNR staff, and several volunteers. The plants have been irrigated with a drip irrigation system and are thriving. Koko Crater Botanical Gardens staff will provide the long term care of these plants and will be propagating *Abutilon menziesii* from materials taken from these plants.

The Kaena Point outplanting site was initiated in April 2001. The outplanting area is about ¼ mile to the west of the site identified in the June 20, 2000 report. The approximately 3-acre outplanting site was established with two distinct planting areas separated by a four-wheel drive road. The site is completely protected from four-wheel drive vehicles by a rock barrier along the dirt road fronting the outplanting site. We prepared the site by clearing the non-native brush and grass with weedeaters and with hand tools. We treated the area with herbicide to prevent regrowth of these non-natives. A total of 61 *Abutilon menziesii* plants were planted by 6 April 2001. We will be planting more plants in the Kaena Point outplanting site by the end of May 2001. When planting is complete we will have two representatives of each of the 62 East Kapolei plants we have propagated. We also planted over 300 other native coastal plants of 20 different species in this site.

A complete irrigation system was constructed at the Kaena Point outplanting site to provide the initial irrigation for these plants. The DLNR received permission from the U. S. Air Force to tap into the 4-inch water main that runs adjacent to the outplanting site. We contracted a plumber to tap into the line and provide a pressure reducing valve, a backflow preventer, a water meter, and a 1-½ inch stub to attach our irrigation system to. We also installed a valve to supply water for fire suppression in the area. We constructed a corrugated galvanized steel water tank with a capacity of approximately 3,000 gallons to provide a water reserve for irrigating the plants. This tank is necessary because the 4-inch water main is pressurized only two days a week for 4 hours per day. The cost of the irrigation water will be an ongoing expense for this project. We consulted with DLNR Historic Preservation Division and they declared that the construction of the outplanting site would have no effect on significant historical sites. We checked with the City and County about the need for a Special Management Area permit. They confirmed that this site is within the Special Management Area. However, the work of developing the outplanting site did not require a permit because was not considered development.

Each outplanting site was planted with a representative sub-sample of the wild plants from East Kapolei and each individual plant will be tagged with permanent metal tags. Maintenance of these sites will be done during the establishment of these plants via weeding, application of herbicide, pesticide, and fertilizer.

As part of the national program to preserve rare species, replicates of all wild individuals will be planted in the living collections at Waimea Arboretum. It is hoped that this will provide seeds for further out plantings and for distribution. We have not done this yet because of the current staffing levels at the Waimea Arboretum

When the above sites are established we will consider other outplanting sites including:

- U. S. Navy land in Lualualei
- Barbers Point
- Kaena Iki/Yokohama Bay
- Diamond Head Crater
- Makapu'u/Queen's Beach
- A current outplanting site on State land near Kealia Trail

Task 4: Research into the biology of the Abutilon menziesii population.

1. *Document Past Research*

The University of Hawaii has not yet been contracted to document past research on the *Abutilon menziesii* population.

2. *Testing*

a) Test granular diazinon for use in controlling ants.

This was done on all plants and it is a very effective treatment in controlling ants.

b) Test Azatin and encapsulated Dursban on a few plants to determine toxicity.

These pesticides provide good control of scale and mealy bugs with no toxicity to *Abutilon.* The first trial was conducted on 6 plants in October 1998. The treatment was shown to be effective in this trial and about one month later the treatment was done on the remaining East Kapolei plants.

c) Test seed storage in appropriate facilities

Seeds have been collected from 39 individual East Kapolei plants and are being stored at the DLNR rare plant seed storage facility. Approximately 700 seeds have been collected from the East Kapolei plants. We have collected over 1,000 seeds from nursery plants grown from cuttings. We provided over 800 seeds to Dr. Alvin Yoshinaga at Lyon Arboretum for seed storage research. Some of these seeds have been sent to the National Seed Storage Lab in Fort Collins, Colorado for long term storage.

We will continue to work on finding the most effective germination technique for *Abutilon menziesii* seeds.

Task 5: Provide partial funding for the construction of a low-elevation greenhouse dedicated to growing A. menziesii and other threatened and endangered plant species on Oahu.

We have been working on getting a site for a nursery for *Abutilon menziesii* that is near the outplanting site and the DLNR rare plant nursery. The preferred site for the low-elevation nursery facility was identified behind Dillingham airfield. We had discussions with the Department of Transportation over a 6-month period and eventually were told that they were unable to lease any portion of the airfield for a use not associated with aviation.

The second site we identified for the nursery is on a portion of land owned by DLNR and leased by YMCA Camp Erdman. This six-acre site is immediately adjacent to the Camp on the Kaena Point side makai of Farrington Highway. YMCA Camp Erdman indicated keen interest in cooperating in the placement of this nursery here. This site is attractive because it is close to a

water and power source. Camp Erdman offers the benefits of 24-hour security and the potential as an educational outreach site for rare native plants. This site is considered a backup site because of the amount of work involved in removing the many iron wood trees on the site. The other negatives are that because the site is so close to the ocean the nursery would receive heavy salt spray and would be threatened by salt water during periods of high surf.

The primary site identified for the nursery is on land owned by the State of Hawaii, and leased to Mr. Ron Weidenbeck of Fish Farms Hawaii. The parcel is located in Lot 3 of TMK 6: 9: 01. Mr. Weidenbeck has approved DLNR removing a portion of Lot 3 to establish a nursery. The advantages of this site are: within a hundred yards of a water source; within a hundred yards of a power source; within a 8 foot high chain link perimeter fence; located away from the direct influence of the waves and salt spray; and above a planned caretakers cabin which will provide oversight of the area. We are currently working with Ms. Charlene Unoki of the Division of Land Management, DLNR to convert the lease of this parcel to the Division of Forestry and Wildlife from Mr. Weidenbeck. We expect to complete the transfer of this property and begin construction soon. We will submit the final report for the Housing and Community Development Corporation of Hawaii when we have completed the construction of this greenhouse.

Appendix G
Final Interim Management Report
for Abutilon menziesii
(October 31, 2003)

Department of Land and Natural Resources
Division of Forestry and Wildlife
Natural Area Reserves System

Final Interim Management Report
for
Abutilon menziesii
Actions completed by the Division of Forestry and Wildlife
October 31, 2003

The following is a summary of activities implemented by the Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW), for the Endangered species, *Abutilon menziesii,* during the 30-month period from April 24, 2001 to October 31, 2003. This is a final report on the interim management activities completed by DOFAW. The Habitat Conservation Plan (HCP) for *Abutilon menziesii* is nearly complete. The Board of Land and Natural Resources must approve the HCP before the plan is considered complete. All future reporting on the management of *Abutilon menziesii* will be done in relation to the HCP.

Project Background

The East Kapolei *Abutilon menziesii* population was discovered in 1996 by Kenneth Nagata during a biological survey conducted for PBR Hawaii, a consulting firm hired by the State of Hawaii agency then known as the Housing Finance and Development Corporation. This survey was done for the East Kapolei Master Plan project that proposed a mixture of residential and community development projects for the area. The East Kapolei area was in sugar cane cultivation for over a century when agricultural operations ceased in spring 1995. The State of Hawaii, Department of Transportation, and the City and County of Honolulu, Department of Transportation Services commissioned another botanical survey by Char and Associates, Botanical Associates, for a proposed highway. The corridor of this proposed highway, known as the North-South Road, passes directly through a significant portion of the East Kapolei Abutilon *menziesii* population. These surveys are documented in previous versions of the East Kapolei Master Plan Habitat Conservation Plan for *Abutilon menziesii.*

In 1999, the State of Hawaii, Housing Finance and Development Corporation, which had changed its' name to the Housing and Community Development Corporation of Hawaii (HCDCH), entered into an agreement with the DLNR/DOFAW for the interim mitigation of the East Kapolei *Abutilon menziesii* population. This agreement (found in Appendix A), which was signed September 15, 1999, was to cover tasks that DLNR/DOFAW completed from October 1, 1998 to March 31, 2000. This agreement was to provide $67,850.00 to complete 5 main tasks in relation to the protection of the East Kapolei *Abutilon menziesii* population and the conservation of the species. The main tasks were: 1) Maintain existing population of *Abutilon menziesii* on State land at East Kapolei, Oahu, Hawaii; 2) Propagate a total representation of plants through seeds and cuttings from the East Kapolei *Abutilon menziesii* population; 3) Establish two wild populations of *Abutilon menziesii* in appropriate habitat; 4) Research into the biology of the *Abutilon menziesii* population; 5) Provide partial funding for the construction of a low-elevation greenhouse dedicated to growing *Abutilon menziesii* and other threatened and endangered plant species on Oahu. A report entitled, Interim Management Report for *Abutilon menziesii,* dated April 24, 2001 documented the work done by DLNR/DOFAW from October 1, 1998 until the report date. DLNR/DOFAW was paid $40,125 for the work accomplishments documented in that

report. All phases of tasks 1, 2, and 4 were accomplished during that period. We were unable to complete all phases of tasks 3 and 5 of the original agreement. We were unable to complete task 3, the establishment of two wild populations of *Abutilon menziesii,* because we had difficulty finding landowners who had suitable habitat and were willing to allow a new population of endangered plant species to be established on their land. The difficulty we had in completing task 5, the establishment of a low-elevation greenhouse, was finding a suitable parcel of State owned land where building a nursery was feasible with a small budget.

A second agreement between HCDCH and DLNR/DOFAW was signed on January 30, 2001 (see Appendix B). This agreement was signed to complete the actions that were not fully completed in the first agreement. This agreement covered actions to complete the establishment of two wild populations, construction of a greenhouse, and the completion of a final report. In this agreement DLNR/DOFAW was to complete the remaining tasks during the period from November 1, 2000 to October 31, 2001. DLNR/DOFAW continued to work through the problems associated with completion of the tasks identified in the second agreement. However, we were not able to complete them all by October 31, 2001. In October 2001, HCDCH was no longer seeking to complete the East Kapolei Master Plan and the agreement was not extended. DLNR/DOFAW did not receive the $27,725.00 that was set aside to complete the tasks in this second agreement. This report will document the completion of all tasks completed by DLNR/DOFAW since April 24, 2001 that were identified in the original agreement. DLNR/DOFAW staff used a variety of funding sources to complete the second outplanting site and complete the nursery. The HCDCH only paid about 60% of the $67,850.00 they had originally pledged to complete the mitigation measures for the conservation of *Abutilon menziesii.*

The North/South Road project of the State of Hawaii, Department of Transportation (DOT), and the City and County of Honolulu, Department of Transportation Services, has become the lead project in the development of the HCP for the East Kapolei population of *Abutilon menziesii.* The DOT has set aside funds to continue work on the conservation of *Abutilon menziesii* until the HCP is finalized, and beyond. These funds have paid for part of the salary of a Horticulturist working for DLNR/DOFAW to work on the completion of the tasks mentioned above. That Horticulturist was hired in March 2001 and he continues to work on the conservation of *Abutilon menziesii*. The DOT funds have also been used to complete the nursery and support tasks related to the conservation of this species.

ACCOMPLISHMENT OF TASKS

Task 1: Maintain existing population of Abutilon menziesii on State land at East Kapolei, Oahu, Hawaii. This work will include the following:

1.Monitoring

A total of 30 visits were made to the *Abutilon menziesii* plants at Kapolei between April 2001 and October 2003. The Horticulturist DLNR/DOFAW hired to work on *Abutilon menziesii* did all the monitoring. The Horticulturist visited the East Kapolei population once a month, or three times per quarter. Each plant has been given a number and a permanent tag. The numbers given to plants followed those assigned during the survey done by Kenneth Nagata in December 1997, where appropriate. The total number of *Abutilon menziesii* at the time of the last report was 90. The DOFAW Horticulturist has found 16 new *Abutilon menziesii* plants in the East Kapolei area since the last report. New numbers were assigned to plants. We have not taken any cuttings from any of these plants. The plants are still too small to be able to withstand the stress of cuttings being

taken from them. One of the 16 new plants has produced seed. That seed has been collected and stored.

The East Kapolei area has been in drought conditions since April 2001. In the spring of 2002, the area did receive a few significant rains. In surveys done at East Kapolei by DLNR/DOFAW in March through May 2002 many *Abutilon* seedlings were found. The Horticulturist decided that the survival of these seedlings was more likely if they were transplanted when they were still small. A total of 31 seedlings from the East Kapolei population were dug up and transplanted in the nearby outplanting site at the Honouliuli Unit of the Pearl Harbor National Wildlife Refuge. 21 seedlings of known parentage and 10 seedlings of unknown parentage that were removed from the East Kapolei population have been planted there. A small portion of the seedlings produced at the East Kapolei population (approximately 10%) during the spring of 2002 were left at East Kapolei and subsequently perished.

In the time since April 24, 2001, several of the original 86 plants have died due to natural senescence. The number of plants still alive is between 25 and 40. Determining whether an *Abutilon menziesii* is still alive is difficult. The plant may appear to be only dead sticks but a heavy rain will cause the plant to suddenly sprout green leaves. Therefore it is difficult to give a definitive total on the plants still alive in East Kapolei. In Appendix C, we have a map with all the *Abutilon menziesii* plants and plant locations noted in relation to existing infrastructure and boundaries. In Appendix D, we provide a map with all known *Abutilon menziesii* plant locations, existing infrastructure, and boundaries overlaid on an aerial photo from PBR Hawaii that was in HCDCH HCP.

2. Maintenance

Irrigation was provided to the 16 new plants to enhance their establishment. A small amount of fertilizer was given to all the live plants. Weeding was done around the base of all plants, including the plants that have died, to discourage the deposition of weed seeds around the mother plant and to reduce competition from weedy species

3. Security

A fire plan has been implemented for the area that created a fire break around the *Abutilon menziesii* populations and individual plants; identifies the fire fighting resources available near the East Kapolei population; and provides information to these resources to assist them with protecting these plants from fire. We have contracted the Hawaii Natural Heritage Program to produce a detailed GIS map of all the known plants and the key fire resources in the area. This map (in Appendix C) will be provided to all the Fire Department Stations listed below for their reference in case of a fire. The TMK for the East Kapolei area where the plants are found is Oahu 9:1:6, parcel 109.

The potential ignition sources for fires in the East Kapolei area are accidental ignitions from children playing with fire, careless smoking, vehicles in dry flashy fuels, misuse of fireworks, and intentionally set arson fires. Fireworks are prevalent during the New Years and Fourth of July holidays and illegal aerial fireworks are becoming more prevalent during these times. The potential of fireworks as an ignition source in Kapolei is quite high. Illegal motorcycle use of the parcel occurs and is another likely source for fires in the area. In late June 2000, we contracted an agricultural disc to create a 30-foot barrier of bare soil around each plant or each cluster of plants. We have not had any significant heavy rains since then to increase the fuel near the plants. Currently this firebreak is still in place. This method of firebreak creation may be more detrimental

than beneficial to the East Kapolei population. The use of the agricultural disc can disturb seeds in the soil bank around the existing plants, which could be detrimental to their germination.

At this time (October 2003) the fuel in the entire project area is light and discontinuous. It is highly unlikely a brush fire could be sustained in the East Kapolei *Abutilon menziesii* population area at this time. The area should be monitored regularly because an extended period of above average rainfall could increase fuel levels sufficiently to present a fire threat.

The nearest Fire Station to the area is Kapolei Fire Station (Station 40). Station 40 is approximately 2.5 miles from the *Abutilon menziesii* populations. The fire fighting resources available at Station 40 in Kapolei are an Engine, a Ladder truck, and a Brush Fire truck. A Honolulu Fire Department Battalion Chief is stationed at Station 40. The next closest fire units are at Station 12 in Waipahu. Station 12 has an Engine, a Ladder truck, and a Water Tender. Station 35 in Makakilo is the third closest unit to the area and it has an Engine on site. Station 28 in Makakilo is the fourth closest unit with an Engine and a Water Tender on station. The GIS map shown in Appendix C shows all the access routes to the main population clusters. This map will be provided the above Fire Stations.

Task 2:Propagate a total representation of plants through seeds and cuttings from the East Kapolei Abutilon menziesii population.

Task 2 was completed before April 24, 2001. The 16 plants discovered since that time have not been propagated from cuttings. These plants are still to small to sustain cuttings being taken from them.

We have not propagated any new plants from seed since April 24, 2001. We have continued to collect seed from the East Kapolei population. There are 52 plants from the East Kapolei population represented in the seed collection at the Lyon arboretum seed storage facility. This total includes seeds from one of the 16 new plants discovered since April 24, 2003.

Task 3: Establish two wild populations of Abutilon menziesii in appropriate habitat

The Interim management report of April 24, 2001 identified two outplanting sites that were the initial sites for the establishment of new wild populations of *Abutilon menziesii.* The first site is on City and County of Honolulu land in Koko Crater and the second is on State land on the Mokuleia side of Kaena Point. Since that report we have completed a third ouplanting site at the Honoululi Unit of the U. S. Fish and Wildlife Service Pearl Harbor National Wildlife Refuge.

1. Koko Crater

The first ouplanting site is located at the Koko Crater Botanical Garden. The Honolulu Botanical Gardens provided a 100 x 100 foot site set aside for the plant for the initial planting. On 16 November 2001, 140 *Abutilon menziesii* were planted at the site provided. The planting was accomplished with Honolulu Botanical gardens staff, DLNR staff, and several volunteers. The plants have been irrigated with a drip irrigation system since then and are thriving. Koko Crater Botanical Gardens staff will provide the long term care of these plants and will be propagating *Abutilon menziesii* from materials taken from these plants. DLNR has provided support to weed the Koko Crater population on periodic visits to the site. This site met the criteria for the establishment of wild

populations under the first interim mitigation plan agreement between HCDCH and DLNR/DOFAW when it was initially established. However, since the establishment of this site, we have received comments from the Endangered Species Recovery Committee and others. These comments have caused DLNR/DOFAW to reconsider the appropriateness of this population to be considered a wild population. DLNR/DOFAW agrees that since this site is within a public display garden that it should not be considered as a wild population for the purposes of the Habitat Conservation Plan. In addition, the plants at Koko Crater have been on drip irrigation since they were planted. This has caused the plants to grow taller and have more luxuriant growth than they would in a truly wild population. DLNR/DOFAW views this population as a living collection representation of the genetic stock of the East Kapolei *Abutilon menziesii* population. DLNR/DOFAW will work with the staff at Koko Crater Botanical Gardens to coordinate the management of this population.

2. Kaena Point

The Kaena Point outplanting site was started in April 2001. The outplanting area is about ½ the distance between the end of the paved Farrington Highway and the vehicle barrier at the entrance to the Kaena Point Natural Area Reserve. The land is under the jurisdiction of the DLNR, Division of State Parks (TMK 6:9:01, Parcel 4). The DLNR Historic Preservation Division declared that the construction of the outplanting site would have no effect on significant historical sites. The City and County of Honolulu Planning Section confirmed that this site is within the Special Management Area. However, the work of developing the outplanting site did not require a permit because was not considered development.

The approximately 3-acre outplanting site was established with two distinct planting areas separated by a four-wheel drive road. The site is completely protected from four-wheel drive vehicles by a rock barrier along the dirt road fronting the outplanting site. The initial cost of installing this barrier was nearly $4,000. This barrier has been challenged by off-road vehicles occasionally and we have improved the barrier in areas where vehicles have attempted to breech the barrier. We prepared the site by clearing the non-native brush and grass with weedeaters and with hand tools. We treated the area with herbicide to prevent regrowth of these non-natives. A total of 61 *Abutilon menziesii* plants were planted by 6 April 2001. We have planted 81 additional plants since April 2001. A total of 142 *Abutilon menziesii* plants have been planted in the Kaena Point outplanting site. The plants were irrigated at the site to promote their establishment. The approach we plan to take at this site is to irrigate the plants to encourage the production of a maximum amount of seed to allow the build up of the seed bank and natural establishment of seedlings. The survival rate for plants at this site has been 98%. The 142 plants at this site represent a total of 44 of the original East Kapolei plants. Two *Abutilon* seedlings have grown naturally from seed produced by plants outplanted at this site. These seedlings have grown large enough to be considered part of this population.

A complete irrigation system was constructed at the Kaena Point outplanting site to provide the initial irrigation for these plants. The DLNR received permission from the U. S. Air Force to tap into the 4-inch water main that runs adjacent to the outplanting site. We contracted a plumber to tap into the line and provide a pressure reducing valve, a backflow preventer, a water meter, and a 1-½ inch stub to attach our irrigation system to. We also installed a valve to supply water for fire suppression in the area. We constructed a corrugated galvanized steel water tank with a capacity of approximately 3,000 gallons to provide a water reserve for irrigating the plants. This tank is necessary because the 4-

inch water main is pressurized only two days a week for 4 hours per day. The cost of the installation of this irrigation system was nearly $12,000 to complete these tasks.

The Kaena Point outplanting site has been a difficult one to maintain. This site was established in area with deep soil that was dominated by Guinea grass (*Panicum maximum*) and koa haole (*Leucaena leucocephala*). We have had difficulty keeping up with the weed threat presented by these species and others at this outplanting site. DLNR/DOFAW has used a variety of labor including regular Natural Area Reserves System employees; temporary workers such as the Emergency Environmental Workforce; and volunteers to control weeds in the outplanting site. This additional labor has barely allowed us to keep pace with the weed threat at this site. The money provided under the HCDCH agreement was used to establish the irrigation system at this site and pay a portion of the first year of the salary for the Horticulturist assigned to work on all the activities concerning the conservation and recovery of *Abutilon menziesii*. Money provided by the State of Hawaii DOT has continued to support this position since 2001. This Horticulturist position has spent the majority of his time working on construction of the nursery dedicated to growing *Abutilon menziesii*. We would not have been able to keep up with the weed threat at this site without the additional labor supplied by regular DLNR/DOFAW employees. We will not be able to continue to support the weed threat control at this site at this level. This is due to other important projects taking precedence and a hiring freeze that has left the Oahu Branch with three vacant positions. It will be very difficult for the Horticulturist to keep up with the weed threat at this outplanting site.

The other major threat to this outplanting site is fire. The fire plan that has been in place at this site is the installation of the water tank that serves as a resource for fire fighting in addition to being part of the irrigation system, installation of a 2 inch outlet to allow fire engine hookup near the road as another fire fighting resource, and the planting of native plants along the perimeter of the outplanting site to serve as a fuel break. These tasks were accomplished. However, the fuel break portion of this fire plan needs to be developed further with a wider buffer of fire resistant species established.

On August 20, a brush fire started by a vehicle about ¾ mile away burned a total of 160 acres along the coastal flats up to the nearby Kuaokala Game Management Area at about 1,100 feet elevation. This fire started late at night and was fanned by winds of 25 to 35 mph. The fire burned to the edge of the outplanting site and around it. The fire moved so quickly that Honolulu Fire Department engine companies were not able to engage the fire near the ignition point, or near the outplanting site. They did fight the fire to prevent its' spread in the Kuaokala GMA on August 21. The fire burned approximately 30 percent of the 3-acre outplanting site. The effects of the fire on the *Abutilon menziesii* plants at the site are unknown at this time. We will not know how many were killed by the fire until the rainy season commences and there is sufficient moisture for growth. The plants along the edge were affected by the flames but not completely consumed. It is possible that many of these *Abutilon menziesii* plants will survive. The fire did burn many of the other native species planted in the area to serve as a fuel break along the front of the outplanting site. This fire would of caused more damage if these plants had not been in place. These fuel break plants will need to be replaced. The fire did destroy all irrigation pipes in the area. The cost to replace this pipe will be about $3,000. The lesson that DLNR/DOFAW has learned from this experience is that the fuel break plantings are the most useful part of the fire plan. The fuel break at the Kaena Point outplanting site needs to be replaced and improved to encompass the entire outplanting site.

The HCP should set aside enough funds to cover the full costs of developing and maintaining an outplanting site. The money provided under the agreement with HCDCH provided funds to install the vehicle barrier and the irrigation system, and provided some funds towards the first year of the Horticulturists' salary. The total cost to establish this outplanting site was more than $20,000. This does not include the cost of staff time of DLNR/DOFAW employees. The cost would have been significantly higher if the site was further from a water source.

The initial establishment of outplanting sites will be the most expensive phase of the project. Future outplanting sites should be chosen with that in mind. Several important factors need to be considered when developing an outplanting site for wild *Abutilon menziesii* populations: 1) The site should have a water source or irrigation method identified and accounted for in the budget; 2) It is important that the weed threat at the site is manageable with limited staffing or, if that is not possible, the work force and the resources necessary to combat the weed threat should be identified up front; 3) The fire threat to the site should be addressed with fuel break plantings; 4) The site must not be too remote as to require significant travel time and effort to get personnel and tools and equipment there; 5) The protection of the site from human impact needs to be considered and addressed in the establishment of the site. The HCP should front load the first few years of the budget to address the costs associated with initial development of outplanting sites.

3. Honouliuli Unit of Pearl Harbor National Wildlife Refuge

A third outplanting site has been developed at the Honouliuli Unit of the U. S. Fish and Wildlife Service Pearl Harbor National Wildlife Refuge that borders the West Loch of Pearl Harbor (TMK 9:1:17). This 37-acre unit is mostly a fresh water wetland managed for a variety of endangered water birds. The entire Honouliuli Unit is enclosed in an eight-foot chain link fence that provides predator control for the birds and security for the plants. There is an upland area within this Unit that we felt was suitable for planting *Abutilon menziesii*. We installed an irrigation system at the site to assist with the initial establishment of plants there at a cost of approximately $2,500.

We have planted a total of 61 *Abutilon menziesii* plants at the Honouliuli Unit. The survival rate of the plants outplanted there is 96%. Plants from cuttings from 21 of the original East Kapolei plants are planted here. In addition, 21 seedlings of known parentage and 10 seedlings of unknown parentage that were removed from the East Kapolei population in the spring of 2002 have been planted here. A small portion of the seedlings produced at the East Kapolei population (approximately 10%) during the spring of 2002 were left at East Kapolei and subsequently perished. Three plants produced from seed were also planted at Honouliuli. The amount area covered by this outplanting site is approximately ½ an acre. There is sufficient area to add many more plants to this site.

The threat to this outplanting site from fire is minimal. The eight-foot chain link fence provides a barrier to most of the possible ignition sources. A buffer of approximately 6 feet of bare ground is in place just inside most of the perimeter fence of this unit to serve as a barrier to predators of the endangered water birds. This buffer strip also serves as a firebreak to the outplanting site. The portion of the fence that doesn't have this buffer has fresh water marsh just inside the fence. The only fire plan we have for this site is to make sure this buffer strip remains in place.

Task 4: Research into the biology of the Abutilon menziesii population.

No further research activities have been conducted on the biology of the *Abutilon menziesii* population. We have continued to collect seed produced by 52 of the original East Kapolei plants. Over 20,000 seeds have been collected.

Task 5: Provide partial funding for the construction of a low-elevation greenhouse dedicated to growing A. menziesii and other threatened and endangered plant species on Oahu.

We have completed the construction of a 6,000 square foot nursery dedicated to the propagation of *Abutilon menziesii* and other threatened and endangered plant species on Oahu. The nursery is located above the Kaena Point end of Dillingham Air Field on the North Shore of Oahu. The nursery is located is located in Parcel 3 of TMK 6: 9: 01. This parcel is owned by the State of Hawaii, managed by the Land Division of the DLNR, and was leased to Mr. Ron Weidenbeck of Fish Farms Hawaii. We are still in the process of getting the parcel under the jurisdiction of DLNR/DOFAW. There have been issues related to some of the other parcels leased to Mr. Weidenbeck in the area that have slowed this process.

This task has been the most difficult one to complete. The most difficult phase was locating suitable parcel of State owned land where building a nursery was feasible with a small budget. We looked at sites on DOT land closer to the Dillingham Airfield and a parcel near Camp Erdman in addition to others. The selection of a nursery site was not complete until October 2001. The site needed a significant amount of groundwork before it was usable as a nursery. The leveling of the site included hauling 300 tons of rock to the site. We finally completed the groundwork in March 2002. The next difficulty was developing construction specifications and getting bids for the construction of the main part of the nursery. This phase took from April 2002 until June 2002. We completed the construction of the main part of the nursery in the fall of 2002. Once the construction of the nursery was complete we installed the shade cloth with the help of DLNR/DOFAW staff and volunteers. The next to the last phase of the project was the completion of the electrical hook up which included the installation of a new power pole, electrical meter, and safety switch. We also had to wire the pumps for the water system, provide power in the nursery for lights, and outfit the storage containers we had moved to the site with lights and power outlets. The final phase of the nursery project was the installation of a water system. This phase required obtaining permission to tap into a line at a nearby concrete reservoir tank, the installation of a 10,000 gallon storage tank, installation of a 1,000 gallon booster tank, installation of pumps to lift water to the upper storage tank and pressurize the nursery supply lines, and installation of the irrigation system within the nursery. These final two phases were completed by the end of August 2003.

The original agreement with HCDCH set a budget of $10,000 to contribute towards the construction of a nursery dedicated to growing *Abutilon menziesii*. The total cost for completing all phases of this nursery was over $68,000.00. We utilized a variety of funding sources to complete the nursery. We utilized $13,189.53 of the funds set aside by DOT for *Abutilon menziesii* during the nursery construction phase of the project. The nursery alone cost more than the entire amount originally budgeted to complete all tasks in the first Interim Mitigation plan for the Endangered Species, *Abutilon menziesii*, between DLNR/DOFAW and HCDCH. The Horticulturist hired with a majority of his salary coming from DOT funds has spent 80% of his work time since October 2001 working on completion of this nursery. The monetary value of his time is not included in the total listed above.

APPENDIX A

BENJAMIN J. CAYETANO
GOVERNOR

DONALD K.W. LAU
EXECUTIVE DIRECTOR

SHARYN L. MIYASHIRO
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DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT AND TOURISM
HOUSING AND COMMUNITY DEVELOPMENT CORPORATION OF HAWAII
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TO: Department of Land and Natural Resources
Division of Forestry and Wildlife
Oahu Branch

DATE: September 16, 1999
ATTENTION: Randy Kennedy

RE: East Kapolei – Interim Mitigation Plan for the Endangered Species, Abutilon Menziesii

WE ARE SENDING YOU X ATTACHED
____ UNDER SEPARATE COVER VIA _____ THE FOLLOWING ITEMS

COPIES	DATE	NO.	DESCRIPTION
1	9/15/99		Executed Agreement for the East Kapolei interim mitigation plan

THESE ARE TRANSMITTED as checked below:

____ For approval
X For your use
____ As requested/required
____ For review and comment
____ FOR BIDS DUE _____ ,

____ Approved as submitted
____ Approved as noted
____ Returned for corrections

____ Resubmit
____ Submit
____ Return

____ copies for approval
____ copies for distribution
____ corrected prints

REMARKS: _____

IF THERE ARE ANY QUESTIONS, PLEASE CONTACT: Leo Domingo TELEPHONE NO. 587-3170

SIGNED: _____
Project Coordinator

COPY TO: _____

IF ENCLOSURES ARE NOT AS NOTED, KINDLY NOTIFY US AT ONCE.

DHS 4308/ (8/87)

AGREEMENT

THIS AGREEMENT is made this 15th day of September, 1999, by and between the HOUSING AND COMMUNITY DEVELOPMENT CORPORATION OF HAWAII ("HCDCH"), a public body and body corporate and politic of the State of Hawaii, whose post office address and principal place of business is 677 Queen Street, Suite 300, Honolulu, Hawaii 96813, and the DEPARTMENT OF LAND AND NATURAL RESOURCES ("DLNR"), State of Hawaii, whose address is 1151 Punchbowl Street, Honolulu, Hawaii 96813, and

WHEREAS, the Department of Land and Natural Resources (DLNR), has title to that certain real property situated at Honouliuli, Ewa, Oahu, Hawaii, containing an area of 1,300.000 acres, and identified as tax map keys: 9-1-016:008, 9-1-016:108, 9-1-016:109, 9-1-017:086, 9-1-017:071, 9-1-018:003, and 9-1-018:005 (collectively referred to as "East Kapolei State Land Bank,") and

WHEREAS, DLNR is in the process of transferring title of the East Kapolei State Land Bank to HCDCH for development purposes in order to satisfy legislative and administrative goals and objectives, specifically to generate funds for the University of Hawaii West Oahu Campus, to facilitate the development of private sector housing units, and to provide off-site infrastructure for the 200-acre site to be transferred to the Department of Hawaiian Home Lands, and

WHEREAS, HCDCH is the designated master plan developer for the East Kapolei Master Planned Development Project, which encompasses the East Kapolei State Land Bank, and

WHEREAS, HCDCH has filed a Final Environmental Impact Statement (FEIS) for the East Kapolei State Land Bank. The FEIS was accepted by the Governor of the State of Hawaii on September 23, 1998, conditioned upon satisfying the requirements of Chapter 343, Hawaii Revised Statutes, and specifically to implement the Habitat Conservation Plan for the endangered abutilon menziesii in accordance with the requirements of the U.S. Fish and Wildlife Service and the State Department of Land and Natural Resources;

WHEREAS, DLNR has the capability of performing the plant mitigation and has the knowledge and expertise to administer the mitigation of the endangered Abutilon Menziesii, and is willing to provide services for the interim mitigation of the endangered Abutilon Menziesii,

NOW THEREFORE, in consideration of the premises above, the parties mutually agree as follows:

1. DLNR shall perform the tasks set forth in "Exhibit A", attached hereto and incorporated herein. DLNR shall provide reasonable safeguards to secure the existence of the endangered Abutilon Menziesii, to maintain the existing plant population, to establish a new "wild" population, and to perform research into the biology of the endangered Abutilon Menziesii.

2. HCDCH will pay to DLNR the total sum of $67,860.00 as set forth in "Exhibit B", attached hereto and incorporated herein. Quarterly payments will be made upon submission of written quarterly reports of progress to HCDCH.

3. DLNR will perform the tasks during an 18-month period, beginning from October 1, 1998 and ending on March 31, 2000.

4. This Agreement shall be null and void if the Habitat Conservation Plan is not approved by DLNR.

5. This Agreement may be terminated at any time by written consent of both parties.

IN WITNESS WHEREOF, the undersigned have executed these presents as of the day and year first written above.

APPROVED AS TO FORM:

Deputy Attorney General

HOUSING AND COMMUNITY DEVELOPMENT CORPORATION OF HAWAII

Donald K. W. Lau
Its Executive Director

DEPARTMENT OF LAND AND NATURAL RESOURCES

Timothy E. Johns, Chairperson
Board of Land and Natural Resources

DEV 21000.19

Exhibit "A"

SCOPE OF SERVICES

A. Task 1

Maintain existing population of Abutilon Menziesii on State lands at East Kapolei, Oahu, Hawaii. This work will include the following:

1. Monitoring

   a. Place permanent stakes for sequence shots.
   b. Record GPS data in notebook and on video soundtrack.
   c. Create a new map with GPS points using GIS.

2. Maintenance

   Maintain existing population by weeding, and applying herbicide, pesticide and fertilizer.

3. Security

   Develop and implement a fire protection plan for the population.

B. Task 2

Propagate a total representation of plants through seeds and cuttings from the Abutilon Menziesii population. These plants will be used to maintain genetic representation of stock and provide stock for outplanting purposes. Work will be done at the existing State DLNR, Division of Forestry and Wildlife (DOFAW) nurseries or at appropriate co-operating nurseries.

C. Task 3

Establish two wild populations of Abutilon Menziesii in appropriate habitat to allow for natural establishment and long term viability. Prepare and implement fire protection plan for the population. Secure wild population from off-road vehicles using boulder barriers.

D. Task 4

Research into the biology of the Abutilon Menziesii population.

1. Contract the University of Hawaii to document past research on the Abutilon Menziesii population.

2. Perform testing and identify testing parameters as follows:

   a. test granular diazinon for use in controlling ants;
   b. test Azatin and encapsulated Dursban on a few plants to determine toxicity;
   c. test seed storage in appropriate facilities in the event of problems with wild populations;
   d. establish testing parameters for outplanting site selection to include, but not limited to, salt influence, occasional storm wave wash influence, associated soil organisms, and accompanying pests.

E. Task 5

Construct a greenhouse dedicated to growing Abutilon Menziesii endangered plant species. The greenhouse would serve as a long-term greenhouse for threatened and endangered plant species on Oahu. Task 5 includes the following scope:

1. Site Preparation

   a. clear and grade the greenhouse site, having approximately 0.5 acres in size; and
   b. construct an eight-foot high chain link fence.

2. Water Supply

   a. develop a permanent water source for greenhouse irrigation;
   b. purchase and construct a 5,000 gallon tank for emergency backup water supply; and
   c. provide irrigation system for greenhouse.

3. Greenhouse Construction

   a. construct a greenhouse using a prefabricated greenhouse kit;
   b. construct two shade structures for preparing nursery stock for outplanting; and
   c. purchase benches, pots, and equipment necessary to operate the greenhouse.

F. Administration

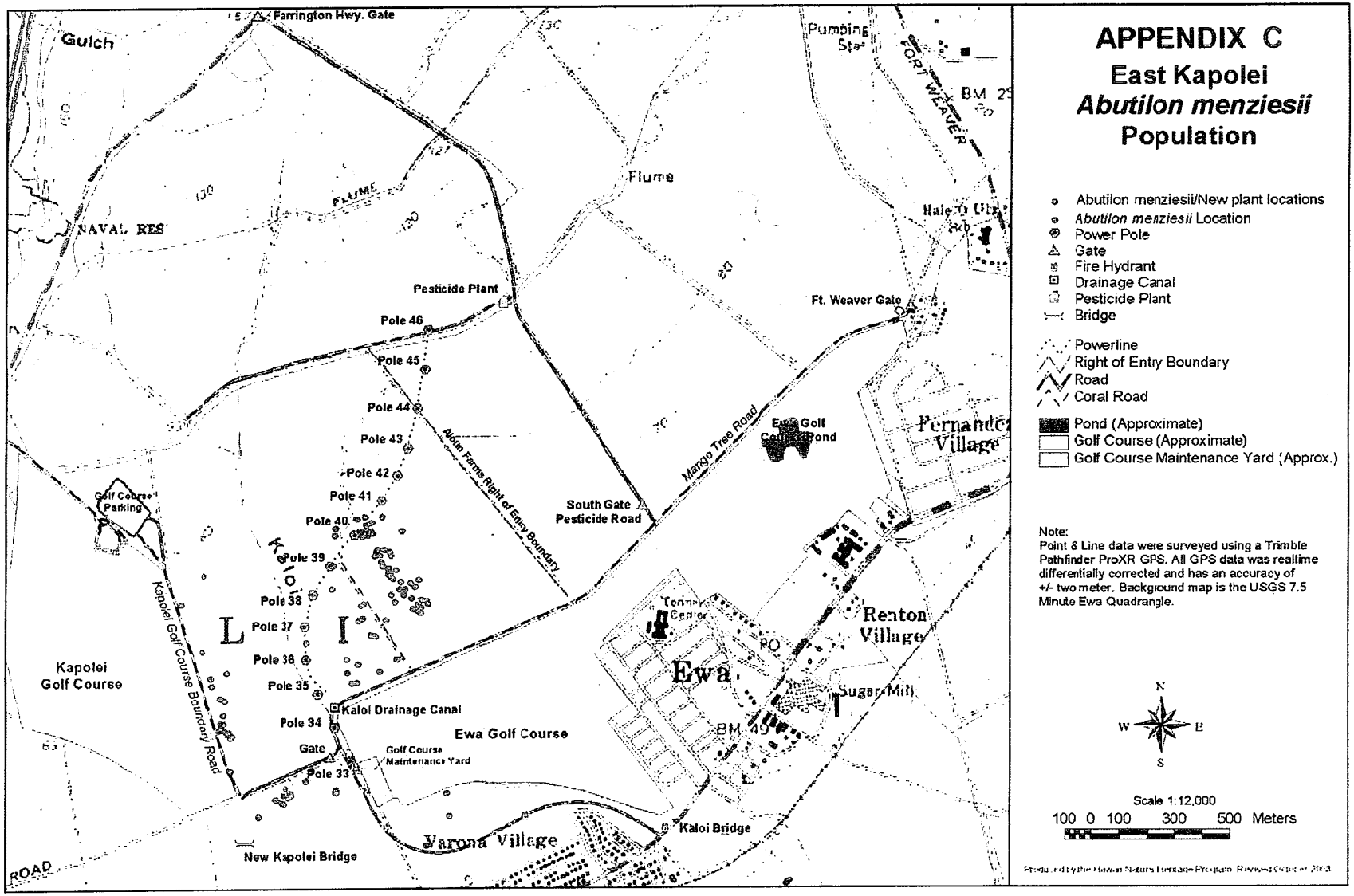
Document findings and prepare quarterly reports of progress. At the end of the contract period, prepare a summary final report which provides a recommendation of action and possible alternatives, if any, based upon documented findings and results.

Exhibit "B"

COMPENSATION

Payment will be made upon DLNR's submission of quarterly reports to HCDCH. Final payment will be made upon DLNR's submission of a final report to HCDCH. Compensation is based upon the following cost breakdown:

Task 1	in the amount of	$18,300.00
Task 2	in the amount of	$10,950.00
Task 3	in the amount of	$16,600.00
Task 4	in the amount of	$ 7,500.00
Task 5	in the amount of	$10,000.00
Administration	in the amount of	$ 4,500.00
	TOTAL COMPENSATION	$67,850.00



APPENDIX C

East Kapolei *Abutilon menziesii* Population

- Abutilon menziesii/New plant locations
- *Abutilon menziesii* Location
- Power Pole
- Gate
- Fire Hydrant
- Drainage Canal
- Pesticide Plant
- Bridge
- Powerline
- Right of Entry Boundary
- Road
- Coral Road
- Pond (Approximate)
- Golf Course (Approximate)
- Golf Course Maintenance Yard (Approx.)

Note:
Point & Line data were surveyed using a Trimble Pathfinder ProXR GPS. All GPS data was realtime differentially corrected and has an accuracy of +/- two meter. Background map is the USGS 7.5 Minute Ewa Quadrangle.

N
W E
S

Scale 1:12,000
100 0 100 300 500 Meters

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